# SUSTAINABLE DEVELOPMENT AND THE ENVIRONMENT

## FAO Policies and Actions

### Stockholm 1972 – Rio 1992

FOOD AND AGRICULTURE ORGANIZATION
OF THE UNITED NATIONS
ROME ITALY 1992

# SUSTAINABLE DEVELOPMENT AND THE ENVIRONMENT

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SUSTAINABLE DEVELOPMENT
AND THE ENVIRONMENT

# *FAO POLICIES AND ACTIONS STOCKHOLM 1972 – RIO 1992*

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
ROME, 1992

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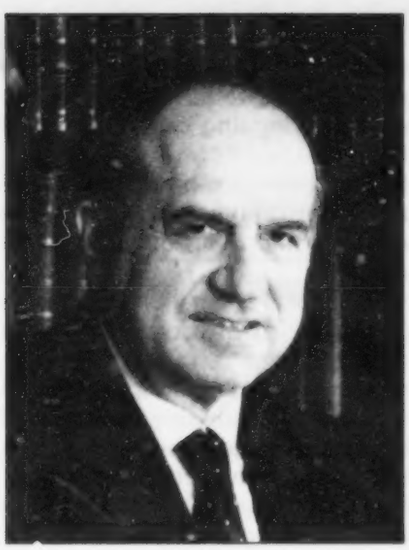
# FOREWORD



*Edouard Saouma*
*Director-General, FAO*

**PEOPLE HAVE ALWAYS** had to compete with nature for their food. The idyllic picture of a Garden of Eden, where gatherers and traditional farmers are at one with nature, does not exist. The actual situation is a constant struggle against the vagaries of climate, weed infestations and disease. The natural equilibrium of ecosystems is achieved through an unremitting battle between species competing for territory and survival. This battle has long been - and still is being - influenced by human interference through agriculture and forest management which alter the natural landscape, favouring certain species at the expense of others and distorting ecosystems to meet human needs.The question is whether agricultural development can be sustained for a growing world population, and whether the ecological balance and the productive capacity of natural resources can be maintained without creating a conflict between man and nature. We need to know what principles and strategies can be used to ensure harmonious co-existence; how to proceed from nature's spontaneous balance to an equilibrium that is capable of meeting the needs of a given population; how to safeguard and enhance the productive potential of the natural resource base.

For as long as technology kept pace with human population growth it was possible to maintain a symbiosis between agriculture and the forces of nature. However, the rapid increase in world population during the past 50 years, and the accelerated pace of technological progress, have resulted in the taming of nature in some parts of the world at the risk of its destruction. It is imperative that we determine the thresholds of tolerance for human interference, and the extent to which agriculture and nature can interact acceptably. The first priority is to feed the world's population. How can hungry people be expected to protect natural resources and the environment, and concern themselves with the well-being of future generations, when their immediate survival is at stake?

Of course, resources must be used better, appropriate technologies must be developed, soil must be protected, genetic resources conserved, water resources better managed and the toxic effects of pest control avoided. All these technical recommendations were voiced 20 years ago at the first United Nations Conference on the Human Environment, held in Stockholm in June 1972. They are even more pertinent today, and should continue to feature in any strategy for the sustainable development of agriculture. However, they have clearly not been enough, nor will they be enough to resolve future problems. Our ability to come up with formulas to reconcile agricultural development with environmental protection depends first and foremost on the status of agriculture and of farmers in our society.

Agriculture performs a vital public function: it feeds people. If one accepts this truth, then one must also acknowledge the agricultural sector's right to priority in the management of the national economy, and recognize the vital role of the farmer in society. It is obvious that the rural sector needs to be able to solve its own problems at all levels, from the

individual farmer, forest dweller and fisherman right up to the producers' associations, ministries of agriculture, and specialized regional and international agencies. The importance of this task should be reflected in the distribution of national resources, in farmers' incomes and in their direct participation in setting national policies.

The efforts that have been made both nationally and internationally must not be underestimated. Without them, ecological stress would undoubtedly be even more severe. Since its inception, FAO has pursued the major goals of ensuring food security and improving the living conditions of rural populations alongside those of conserving natural resources and protecting the environment. At the same time, it cannot be denied that erosion is outpacing erosion control, that the annual rate of deforestation is far in excess of the area being reforested, and that water pollution and food contamination are worsening. If, as we believe, we now know what needs to be done or not done, technically speaking, why have we failed to eliminate these problems? It is primarily because we have attempted to deal with the symptoms rather than the underlying causes. The real enemies are poverty and social inequality.

Many factors outside the agricultural sector also hinder sustained development, most notably the paralysing indebtedness of many developing countries, the glaring inequity in the terms of North-South trade and the problems of access to technology.

The first goal is to achieve a broad international and national consensus on the common objectives and general principles of sustainable development polices and strategies, and in recent years FAO's Member Nations have begun this process by preparing and adopting special action programmes in a number of areas linked to sustainable agricultural development. The time has now come to integrate these initiatives through comprehensive international cooperation in support of national programmes for sustainable agriculture. FAO, anxious to contribute to this undertaking, has laid the foundation for such a programme in the form of an International Cooperative Programme Framework for Sustainable Agriculture and Rural Development, linking efforts outside agriculture with those in the agricultural sector itself.

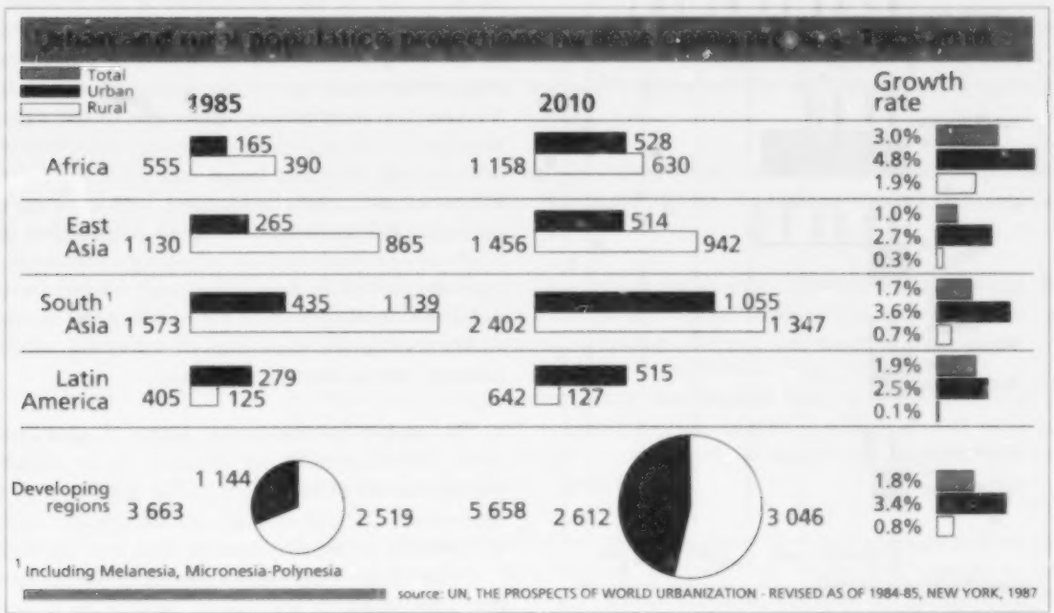
Fostering the acceptance of new ideas and concrete international cooperation is an undertaking that requires great perseverance, and FAO has never failed to exhibit this mundane but effective virtue since its inception in 1945. Constrained as it often is to proceed by small steps, the fruitfulness of its action is often apparent only if viewed in the long term. The present review of FAO's involvement in sustainable development and environmental protection provides a background to, and guiding principles for, a broad-ranging programme of international cooperation towards the elimination of hunger and poverty for present and future generations.

Edouard Saouma
Director-General, FAO
Rome, May 1992

# PART 1:
# TOWARDS THE 21st CENTURY

## THE CHALLENGES

**FOR THOUSANDS OF YEARS**, agriculture has been the activity most essential to human survival and well-being. In many parts of the world, however, it is not fulfilling its vital function of feeding people, providing other basic commodities and generating stable income. Rapid population growth and accelerated urbanization have created a pressing need for more and more agricultural outputs. By the year 2025, an estimated 57 percent of the populations of developing countries are expected to live in urban areas, compared with 34 percent at present. Accelerated demand for agricultural products has exerted ever-increasing pressures on the natural resource base, resulting in excessive deforestation, loss of biological diversity, degradation of soils and various forms of pollution and contamination.



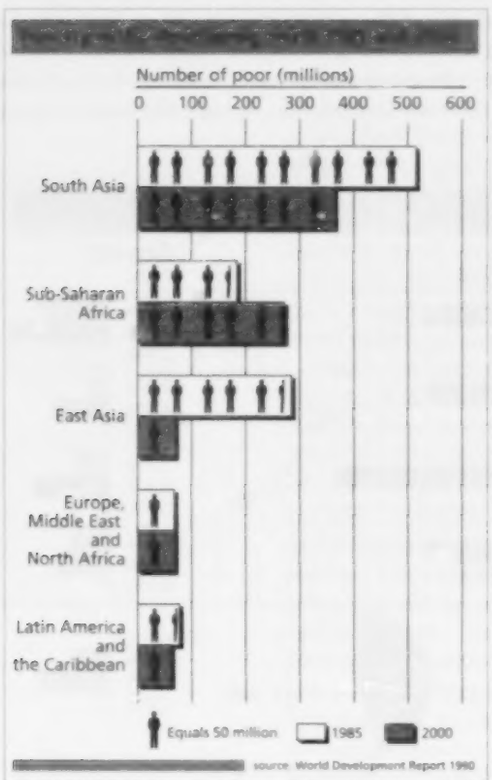

**Urban population growth** puts great pressure on the natural resource base. By 2025, nearly two-thirds of the world's people will live in cities. To feed them without further degradation of the environment, food production should be intensified by using resources more efficiently and in a sustainable way.

Ecological, economic and social imbalances not only affect the present generation but are also a threat to those of the future. Bearing in mind the expected role of agriculture in society and in the economy as a whole, the relationship between agriculture and the environment must be reconsidered so that this vital activity can be maintained on a sustainable basis. The lifestyles of the rich, with their excessive claims on global resources, will have to be modified, while the living conditions of the poor, which compel them to endanger the natural resource base to meet their needs, will have to be improved.

Strategies for sustainable agriculture and rural development should address three main challenges:

- By the year 2025, an additional three billion people will have to be fed from a finite resource base. Already, more than 600 million people are undernourished and some 50 million are threatened by food shortages and famine in developing countries. Further intensification of agriculture is therefore imperative to meet present and future demands and to avoid further

encroachment on marginal lands and fragile ecosystems. However, intensification as practiced at present, particularly in developed countries, carries with it problems of pollution and contamination, waste disposal and loss of biodiversity which can affect not only the natural resources and the environment, but also human health.




**Poverty inevitably leads to land degradation, as the poor are forced to endanger the natural resource base to meet their short-term needs.**

✦ In most countries, agriculture does not offer sufficient opportunities for gainful employment. Disparities in the living conditions of rural dwellers, and between rural and urban populations, are increasing. In developing countries it is often poverty that forces rural people either to eke out their livelihoods at the expense of the natural resources that are their sole means of survival, or to leave the countryside in search of employment in cities or abroad.In many developed countries, farmers' incomes are increasingly vulnerable to the vagaries of weather and markets: farming populations are decreasing, leaving large tracts of land sparsely inhabited and largely unattended, with growing risks of degradation. Meanwhile, as urban populations grow in both developed and developing countries, more intensive forms of agriculture and related processing industries develop to meet the needs of the city markets, so increasing the problems of adjusting supply and demand, and of disposing of wastes.

✦ The search for sustainable forms of agriculture and rural development is related to a number of environmental threats, such as the depletion of natural resources, climate change, air and water pollution, deforestation, desertification and loss of biological diversity. While local environmental problems have long been documented, the role of agriculture as culprit or victim is far from being fully assessed. These risks demand a precautionary approach, which places additional constraints on the agricultural sector and on rural areas and, more generally, may call for changes in consumption patterns, particularly those of affluent societies.

Meeting these challenges calls for major structural adjustments, not only within the agricultural, forestry and fisheries sectors but also in the overall framework of policy which governs the relationship between these sectors and other sectors of the economy at national and international levels.

## THE POLICY FRAMEWORK

**IF, TO BE SUSTAINABLE,** agriculture must meet the challenges of food security, provide more employment and better incomes and contribute to the eradication of poverty, while at the same time conserving natural resources and protecting the environment, then the status and role of farmers in our societies must be commensurate with these responsibilities. The terms of trade between the agricultural sector on the one hand, and industry and the tertiary sectors on the other, should better reflect the services rendered by agriculture to the general

public. Similarly, the terms of trade between agricultural producers and those who process, market and consume agricultural products - urban dwellers in particular - must be changed to take better account of the cost to farmers and other rural people of natural resource conservation and environmental protection. Furthermore, North-South and East-West adjustments in commodity prices should be effected in such a way as to enable farmers to make a sustainable living from agriculture without being forced to cause further environmental degradation and depletion of the resource base.

**At national level**, an overall policy framework to promote sustainable development while safeguarding the natural resource base should aim to:

- Create an overall economic environment conducive to growth with equity by setting norms and standards, overseeing and if necessary regulating markets, implementing land and tenancy reforms and compensating for social inequities.

- Create an overall policy environment that enables and encourages people's participation, and within which individuals can express choices and associate with others.

- Establish an appropriate policy for human settlements, exploiting the benefits of both urbanization (larger, denser markets and easier provision of basic services) and ruralization (better food and fuel security).

- Establish a population policy that aims at both a sustainable rate of population growth and a population size at which growth should stabilize, given current knowledge of the stock of natural resources and the technologies available to exploit them.

- Induce changes in lifestyles, dietary habits and other consumption patterns, especially in the more affluent societies, to promote frugality in the consumption of goods and so reduce wastage and ease the pressure on the resource base and the environment.

**At international level,** policies and actions should be designed to:

- Ensure an economic environment that is conducive to sustainable development by reducing the burden of international debt which so seriously impeded growth in the 1980s for the most highly indebted countries, and by establishing clear guidelines on fair trading practices in order to avoid 'environmental protectionism'.

- Assist developing countries in gaining access to improved technologies that will permit more economic and environmentally-acceptable use of natural resources, greater economy and efficiency in the use of energy and renewable resources, and greater use of yield-enhancing biotechnologies.

- Ensure that actions to develop shared natural resources, such as rivers or their basins, are sustainable on a regional as well as national basis. This will involve research, negotiation and an integrated approach to development.

Regional action can also extend to the control of transboundary pollution.

- Conclude international agreements, including codes of conduct aimed at setting common standards and rules to promote sustainable practices.

- Develop international financial and technical cooperation in ways that will enhance sustainability objectives while limiting the financial burden, especially for poor countries and the poor in those countries.

Alongside the establishment of an appropriate economic and policy framework, the attainment of sustainable development objectives will require increased people's participation. Local communities must be enabled to take more responsibility in decision-making and in implementing rural development programmes, and this will require rapid progress towards decentralization through the devolution of power down to local level, and the provision of incentives for local community initiatives and people's participation. To this end, clear rights have to be allocated with regard to resource use at local level, including those related to the role of women in agriculture. Education, training and support services must also be provided so that people can assume responsibility for managing their resources sustainably and for protecting their own environment.

**People's Participation** directly involves the poor as planners and decision makers in sustainable development. In Sierra Leone, villagers meet to evaluate community development.

## THE ROLE OF THE AGRICULTURAL, FORESTRY AND FISHERIES SECTORS IN SUSTAINABLE DEVELOPMENT

Establishment of an appropriate policy framework across sectors is of paramount importance in achieving sustainability objectives, but most of the concrete action

to be taken for operational implementation is the responsibility of specific sectors, of the institutions dealing with these sectors in particular, and of the communities and individuals actually involved in these branches of the economy. It is therefore essential that each sector determine its role, its objectives and contributions towards sustainable development. This task is particularly urgent and imperative in sectors such as agriculture, forestry and fisheries which play a vital role in meeting basic human needs and in managing a very large segment of the earth's natural resources.

***Sustainable agriculture and rural development (SARD)***

FAO's approach to sustainable agriculture is inspired by considerations of human needs, poverty alleviation and the creation of production incentives. It also recognizes the crucial role of human resources in every sphere of sustainable agriculture and rural development. Natural resources are used and managed by people to safeguard their well-being, not simply for the sake of conservation. Hence, the conservation of natural resources is not just a technical issue: it has important economic and social dimensions. Access to inputs, improved land tenure conditions, economic incentives and sound agricultural policies are crucial in ensuring the sustainable management of the natural resource base. (See panel below.)

Sustainable agriculture is therefore closely linked to rural development, and

## *SUSTAINABLE DEVELOPMENT*

In the words of the definition adopted by FAO, sustainable development is:

'... the management and conservation of the natural resource base, and the orientation of technological and institutional change, in such a manner as to ensure the attainment and continued satisfaction of human needs for present and future generations. Such sustainable development (in the agricultural, fisheries and forestry sectors) conserves land, water, plant and animal genetic resources, is environmentally non-degrading, technically appropriate, economically viable and socially acceptable.'

In addition to covering the essential ecological aspects of sustainable development, this definition also gives equal importance to agronomic, economic and social issues. Optimal resource use and environmental management are combined with increased and sustained production, secure livelihoods, food security, equity, social stability and people's participation in the overall development process. This definition implies fair access to and distribution of production opportunities, economic motivation, equitable distribution of income, development of human resources and optimal use of natural resources.

The problems of sustainability differ markedly between developed and developing countries. In developed countries they may arise from over-use of agricultural inputs, improper tillage or continuous mono-cropping. In developing countries, they are usually related to lack of agricultural inputs, the low productivity of manual labour and the reduced fallow in shifting cultivation. In developing countries environmental damage is often due to low-intensity agricultural practices which require horizontal expansion of cultivation on to marginal areas prone to degradation. Sustainable development in developing countries should therefore be sought within an overall framework of growth,so that the development measures adopted can maintain a momentum towards the goal of a more effective, stable and productive agricultural sector.

the two concepts are combined in FAO's strategy for the future, which takes into account the wide diversity of ecological, cultural, social and economic conditions under which agriculture is practiced. The primary goals of agriculture are to ensure food security for all, both in terms of quantity and quality; to provide employment, and to improve livelihoods and security of income in rural areas. Sustainable agriculture should be achieved as part of a dynamic process of rural development. Trade-offs between sustainable development and the conservation of resources must be given due attention. Furthermore, considerations of intergeneration equity - meeting the needs of future generations - should not overshadow the need to solve the acute intrageneration problems of alleviating poverty and hunger at present.

The Conference on Agriculture and the Environment, organized jointly by FAO and the Government of the Netherlands in April 1991, discussed strategies and tools for sustainable agriculture and rural development with particular reference to the developing countries. The Conference identified eight prerequisites if the challenge of sustainable agriculture and rural development (SARD) is to be met in the years to come:

—Agriculture, in both the developed and developing worlds, should be restructured in such a way that the demands of sustainability can be met.

—The developed countries should recognize their role in, and responsibility for, sustainable agriculture and rural development in developing countries by improving international economic relations. In this way they will be able to increase and stabilize incomes for farmers and so create incentives for appropriate investments in rural areas.

—The international community must accept the need to provide technical and financial assistance in specific fields to promote SARD; to review and improve the rules governing international trade in order to provide better access to markets and ensure fair prices, and to strengthen development financing that will make investment in SARD feasible.

—Population policies should aim in the long term at improving prospects for sustainable development.

—Governments and society at large should recognize that agriculture and rural people collectively perform a vital role in ensuring food security and maintaining the renewable natural resource base. For most developing countries, this recognition must be reflected in the allocation of adequate financial resources, in pricing policies, in the decentralization of institutions and in the empowerment of rural people, particularly the poor.

—Fair terms of exchange should be established among agricultural producers, industry and consumers.

—Farmers, particularly small-scale and resource-poor farmers, both men and women, should have better access to education and training, and to appropriate technologies and resources.

—Campaigns should be undertaken to increase public awareness of the need for SARD.

In evolving towards more sustainable production systems, agricultural and rural development efforts should ensure the attainment of three essential goals.

—**food security** - by ensuring an appropriate and sustainable balance between self-sufficiency and self-reliance;

—**employment and income generation** in rural areas, particularly to eradicate poverty; and

—**natural resource conservation and environmental protection.**

To meet the declared objectives of SARD, most developing countries will have no choice but to intensify their agriculture; but experience in developed countries shows that intensification can lead to pollution and problems of waste disposal. The developing countries will therefore need forms of agricultural and rural development that allow for an appropriate balance between intensification and diversification in the choice of production systems, technologies and practices. (See panel, page 10.)

The demanding process of SARD will require enlightened and skillful participation of the primary producers, technicians, researchers, planners decision-makers and managers of developing countries. New programme initiatives will be needed, together with reallocation-allocation of resources and additional financial resources for human resource development efforts, particularly in the areas of formal and non-formal education in agriculture, forestry, fisheries and rural development, and in action areas that mobilize trained manpower in the development process. However, the acquisition of new investment and the reallocation-allocation of existing financial resources will involve adjustments that may initially reduce the overall production and income of some producers. The agriculture sector may therefore require assistance from other sectors of the national economy and, in developing countries, from the international community.

**Since its inception the Organization has pursued the effective use of natural resources toward increased agricultural production and the well-being of rural populations.**

The challenge of overcoming poverty and translating the SARD concept into an operational reality is the responsibility of the world as a whole, and FAO is prepared and committed to play a major role in this undertaking. Since its inception, the Organization has pursued the effective use of natural resources toward increased agricultural production and the well-being of rural populations. The intensive involvement of FAO with agriculture and environment in the 1970s and 1980s emphasized that people matter, and that it is possible to cooperate with nature without over-exploiting it.

***Forest resources development and the environment***

To foresters, sustainability has been an integral part of planning and management for more than 200 years. Classical forest management concepts include those of sustained yield, allowable annual cut, the even distribution of age classes and the maintenance of species diversity. Since its inception, FAO has assisted Member Countries in forestry by emphasizing trees and forests as a renewable natural resource and by contributing to the understanding of the role of trees and forests in rural development, food security, conservation of genetic resources, wildlife management, wind erosion control and watershed management.

Since the early seventies a series of FAO meetings and programmes has

## ALTERNATIVE AGRICULTURE

In the 1980s, agriculture in industrialized countries came face to face with itself. A marked intensification of agricultural practices - due in part to strong government support to the agricultural sector - resulted in both economic and environmental problems. Modern production methods, based on high capital investment and purchased inputs, implied high costs not only in monetary terms but also in the form of water pollution, soil erosion, pesticide residues and the development of pest resistance to chemical control measures. As a reaction to this situation, a call for 'alternative agriculture' was voiced, with a view to reducing input costs, preserving the resource base and protecting human health.

Alternative practices include incorporating natural processes such as nutrient recycling, nitrogen fixation and pest/predator relationships into the agricultural production process; reducing the use of off-farm inputs (especially those that are a potential hazard to environment or health); making greater use of the biological and genetic potential of plant and animal species; matching cropping patterns with the potential and limitations of the physical resource base, and improving farm management with respect to the conservation of soil, water, energy and biological resources. At the same time, land set-aside programmes are being promoted to avoid surplus production.

Among the low-input technologies now in use, biological farming is becoming increasingly important, especially in Europe. Various different methods have been developed, but all are based on the premise that the individual farmer should be considered the smallest functional unit of production. Biological farming involves the whole farm in a structured system, treating it almost as a living organism. All the different branches of production are harmonized, the production cycle is closed as far as possible, and external inputs are restricted to the absolute minimum required.

The exchange of experimental data and experience in low-input technologies could make a significant contribution to the improvement of biological farming in Europe, and in recognition of this the FAO Regional Office in Europe (REUR) in collaboration with the Swiss Federal Research Station for Agricultural Chemistry and Hygiene of the Environment organized the 'Expert Consultation on Biological Farming in Europe: Challenges and Opportunities'. The Consultation was held during 28-31 May 1990 in Bern, Switzerland, and was attended by roughly 100 experts from 17 European countries and from various international organizations.

In developing countries, however, 'alternative agriculture' does not have the same connotations. In these areas, agriculture is characterized by minimal economic incentive, low levels of inputs, low yields, low capital investment, low productivity of human labour, and a relentless expansion of arable land at the expense of forested areas. Although high-input agriculture may not be the ideal model, it should be realized that the major constraint to agriculture in developing countries lies at the other end of the spectrum, and that there is a need to boost incentives and inputs rather than tune them down. Full use should be made of the experience of traditional farmers, and this should be allied to a better understanding of the production potential of local environments, the findings of agricultural research, and the support of government policies. First and foremost, 'alternative agriculture' in developing countries must be geared to increasing production in order to overcome the drudgery, poverty and harrowing shortages of food which are a major threat to life in these countries.

provided evidence and documentation of the Forestry Department's involvement in integrated rural development and sustainable development. The seventh World Forestry Congress, held in Buenos Aires in 1972, had as its theme 'Forests and Socio-economic Development', and the eighth, in Djakarta in 1978, 'Forests and Population'. The Department also participated significantly in the World Conference on Agrarian Reform and Rural Development (WCARRD) held in Rome in 1979. Around the same time a new major programme 'Forestry for Local Community Development' (FLCD) was started with support from the Swedish International Development Authority (SIDA). This programme has now gained the support of a large number of donors under the name 'Forests, Trees and People' (FTP).

The contribution of forestry to food security was documented in relation to the tenth session of the Commission on Food Security, held in Rome in 1985. This contribution covers among other things three important aspects of sustainable rural development: direct food production (wild fruits, wild animal meat, honey, mushrooms, etc.); conservation of the resource base (soil and water conservation, windbreaks, organic material, nitrogen fixation, fuelwood production, etc.) and generation of income and employment in rural areas (wood for construction, furniture and handicrafts; fuel and fodder production; tourism and non-wood forest products).

Forestry developments in the years ahead are outlined in three major series of documents/events, all with a strong FAO involvement. These are: the Paris Declaration of the Tenth World Forestry Congress and the follow-up action proposed; the documentation prepared for UNCED including 'Agenda 21' on forests; and the Tropical Forests Action Programme (TFAP).

Originally called the Tropical Forestry Action Plan, TFAP was launched in 1985 with the following goals:

—to increase awareness of the problems of deforestation and to mobilize the commitment of all levels of society to address them;

—to introduce intersectoral planning approaches, involving all relevant partners, to allow the generation of effective policies and programmes; and

—to mobilize national and international resources to assist the implementation of plans in a coordinated manner.

**From 1991, the incipal goal of TFAP has remained the curbing of tropical forest loss.**

From 1991, the principal goal of TFAP has remained the curbing of tropical forest loss by the promotion of the sustainable management of tropical forest resources while meeting local and national needs. However, five years of experience have led the TFAP to revise and refine its objectives, principles and procedures. The revised objectives emphasize national leadership, multidisciplinary approaches and the involvement of forest-dependent people in the preparation and implementation of national action plans. Procedures are more flexible and whenever possible coordination is carried out at the country level.

In all FAO activities the questions of biological as well as financial and institutional sustainability, the elimination of rural poverty and the management of forests as a renewable natural resource for present and future generations, are accepted primary objectives.

***Fishery resources, development and the environment***

The foundations of current FAO fisheries policy were laid in 1984 when the Organization adopted its Strategy for Fisheries Management and Development. The Strategy includes principles and guidelines for the sustainable use of fishery resources and the protection of aquatic habitats from pollution and other forms of degradation. Its long-term goal is to improve national capacity to deal with the complex issues related to sustainable development of fisheries and their implications for environmental management.

Although the majority of fisheries are not threatened by extinction, urgent action is required at several levels (fishing communities, national policy and planning departments, regional fisheries organizations and international agencies) to arrest the present degradation of habitats, to rehabilitate them and to promote conditions for sustainable fisheries in watersheds, coastal zones and the high seas. To these ends, FAO's principal aims are to raise general awareness, improve information systems, increase the rights and responsibilities of fishing communities, improve national decision-making mechanisms, and make better use of international organizations, legal and institutional frameworks and the United Nations Convention on the Law of the Sea (UNCLOS).

Research is needed, particularly at national level, to establish resource inventories; to assess the economic value, degree of exploitation and status of individual species; to define acceptable rates of use; to analyse trade-offs between development activities and possible environmental damage, and to study the environmental impacts of intensive coastal and inland aquaculture.

Concern for the conservation of biodiversity is reflected in the FAO/ICES Code of Practice for Consideration of Transfers and Introductions of Marine and Freshwater Organisms. FAO is pressing for the Code to be more widely accepted and more rigorously enforced to avoid the spread of diseases and the introduction of undesirable species into coastal fisheries. Biotechnology as applied to fisheries is still in its infancy compared with current agricultural applications, but this area must be carefully monitored, both for its possible benefits and for any risks it may represent to aquatic ecosystems.

Issues related to sustainable development, food security and environmental protection have high priority. Of particular concern are the environmental problems that may arise from multiple use of watersheds and vulnerable coastal habitats such as mangroves, deltas, lagoons and intertidal zones. Such critical habitats must also be monitored for any impacts of climate change, and appropriate national and regional contingency plans should be prepared.

**The goal is to bring fishing intensities to levels that are economically viable, ecologically sound and socially acceptable.**

Many of FAO's actions and policies focus on the need to improve long-term efficiency and reduce waste. The goal is to bring fishing intensities in inland waters and the sea to levels that are economically viable, ecologically sound and socially acceptable. Recommended steps include the limiting of subsidies to remedial and initial development measures only; the imposition of resource and environmental fees; development of national administrations to take responsibility for the management of coastal areas, and the improvement of gear selectivity and fishing techniques to reduce the numbers of young fish caught and the incidental mortality of non-target species. Other actions should restrict the numbers of vessels using gears that damage the environment, or restrict the areas in which such gears may be used. In particular, FAO is anxious to help develop guidelines for the effective marking of gear and vessels to improve enforcement, minimize conflicts and reduce the loss or deliberate discarding of gear at sea.

# PART 2:
# FAO'S INVOLVEMENT OVER THE YEARS

## *THE INITIAL PERIOD: 1945-1959*

**FAO WAS FOUNDED ON 16 OCTOBER 1945,** the first of a new generation of international organizations. Eight days later, on 24 October, the United Nations itself came into being. By these actions, and for the first time, the nations of the world joined together in a common cause: to raise levels of nutrition and to improve the production and distribution of food and agricultural products. Malnutrition and food surpluses, poverty and plenty, have often co-existed in the past but it was within the framework of FAO that the possibility was seen of finding solutions to these problems through international cooperation and a world food policy based on human needs and universal equity.

FAO's role was laid down in its Constitution by its Member Governments, which determined the activities the Organization should promote and undertake. One of them was 'to promote and, where appropriate, to recommend national and international action with respect to the conservation of natural resources and the adoption of improved methods of agricultural production'. These activities were aimed specifically at raising the levels of nutrition and standards of living of rural populations.

FAO has pursued this mandate through six main activities:

—collecting the data, developing the analytical tools and identifying the policy measures required to formulate and implement sound land-use and resource conservation strategies;

—catalysing the development and uptake of improved technologies;

—fostering a participatory approach to development so that resource-poor farmers have the means and the incentives to adopt sustainable agricultural practices;

—pressing for the better integration of environmental concerns in agricultural and economic policies;

—encouraging coherent policies that acknowledge that economic and ecological sustainability are dependent on farm-level responses to incentives, inputs, institutions and infrastructure; and

—supporting agricultural research at the national and international level.

These activities have been conducted since the early days of FAO's existence, implicitly addressing the concepts of sustainable development and protection of the environment even though not describing them as explicitly as at present. Perhaps the finest statement that has ever been made of the Organization's responsibilities in this field appears in the document *The Work of FAO*, submitted to its first Conference in October 1945:

> "Over those parts of the earth not covered by water lies a thin crust of soil, perhaps equal by comparison to the thickness of a sheet of tissue paper wrapped around a globe. Much of this soil is inaccessible for cultivation or is unusable for other reasons. From the rest, the world's growing population, now more than two thousand million, must draw all their sustenance except for what they get from the sea; and even the fishes, like all other living things, are fed in the final analysis out of the fertility of the land. Whether this

thin layer of soil is to be a wasting asset, or one maintained in perpetuity and made more fruitful for mankind, will depend on how it is used and managed. Nothing more deeply concerns the well-being of men and nations. FAO is dedicated to furthering good use and good management, in all ways and by all peoples, of this most basic of man's resources."

The titles of the first *FAO Agricultural Studies* are indicative of the work carried out in these early days in the field of resource management. They included:

—*Breeding livestock adapted to unfavourable environments* (1948)

—*Using salty land* (1948)

—*Soil conservation* (1948)

—*Efficient use of fertilizers* (1949)

—*Weed control by growth-regulating substances* (1951)

—*Improving the world's grasslands* (1951)

—*Communal land tenure* (1953)

—*Legumes in agriculture* (1953)

—*Soil surveys for land development* (1953)

—*Plant exploration and introduction* (1958)

—*The grass cover of Africa* (1960)

—*Forest influences* (1962)

These studies were part of FAO's core activities of gathering, analysing and disseminating information in order to assist governments in the effective management of their natural resources

Immediately upon its establishment, FAO took over the collection and publication of agricultural statistics which had been pioneered by the International Institute of Agriculture, founded in 1905. In 1948, the Organization took the lead in developing a system of internationally comparable index numbers for agriculture, and these have been continuously refined in later decades. FAO's International Food and Agricultural Commodity Data System has now become the world's premier source of statistics on agriculture, forestry and fisheries.

From the early days, FAO has addressed the need to establish a balance between environmental requirements, the limited availability of resources, and the need for increased agricultural production. In his foreword to the *Agricultural Study on Soil Conservation*, Lord John Boyd Orr, the first Director-General of FAO, stated: 'If the soil on which all agriculture and human life depends is wasted away by erosion, then the battle to free mankind from want cannot be won'.

FAO's advisory role, performed through the provision of technical information, was strengthened from 1950 onward by the Organization's participation in the Expanded Programme of Technical Assistance (EPTA). The fifth session of the FAO Conference, held towards the end of 1949, specified that the approach to EPTA projects should be "through the culture of the local people' and in accordance with their 'accustomed ways and institutions". By September 1951, more than 100 projects were in operation in 35 countries, and by 1959 over 1 700 experts had served in the field, more than 1 600 fellowships had been awarded and about 100 training centres had been organized. A great number of these projects were devoted to soil surveys, the assessment of water and forest resources, locust control, fisheries development and other aspects of resource management aimed at increasing agricultural production.

It is worth noting that the statement above, quoted from the first FAO Conference, in 1945, refers to the world's growing population as "... now more than two thousand million". This figure highlights the extent to which the problems addressed by FAO today differ from those it faced at the time of its inception. Broadly speaking, the problems are much the same as they were in earlier years, but with a world population tending towards six thousand million by the end of this century the issues have drastically changed in magnitude, urgency and complexity. Sustainable agriculture has clearly evolved beyond the more technical and economic problems with which the Organization dealt in the early years: today it also encompasses social and political dimensions of international importance.

## *RAISING PRODUCTIVITY: 1960-1971*

In 1960, the world's population reached three billion. For the first time in human history, global population had increased by one billion people in a mere thirty years: it was the start of the so-called 'population explosion'. Food problems could not be solved simply by the distribution of surpluses which had accumulated in industrialized countries in the 1950s: they now required that food production be stepped up in the countries where it was most needed. It was obvious that solutions would not materialize solely through providing information and advice, but that support had to be provided in the field in order to promote and hasten agricultural development at country level.

**Food problems now required that food production be stepped up in the countries where it was most needed.**

Field activities had started in the 1950s under the EPTA and the Regular Programme in the form of missions, investigations and special projects. These activities demonstrated the availability of usable natural resources but there were no financial resources to undertake the wider surveys and planning exercises needed for their development. Technical assistance made it possible to give advanced training to some technicians but it also demonstrated the need to train many more. It was in order to implement larger and more comprehensive aid programmes that the United Nations Special Fund was set up in 1959. It became fully operational in the 1960s. By 1965, FAO had been assigned 210 Special Fund projects with a total fund contribution of US$180 million and matching contributions of US$221 million from governments. More than 500 FAO staff were engaged. Concurrently FAO was sharing, with the United Nations, the administration of the World Food Programme which allocated resources in the order of US$30 million per year to support development projects in some 50 countries. FAO was also advising the World Bank on the feasibility of agricultural development programmes, for which up to US$100 million were granted

annually as loans. In 1964 the Organization and the World Bank jointly created a cooperative programme through which FAO could assist Member Nations in the identification and preparation of agricultural development projects suitable for World Bank financing. From being mainly an advisory body, FAO had become an operational organization, assisting countries to prepare overall development plans, helping to execute major projects and helping countries to obtain finance for national development. The volume of the Organization's externally-funded field projects soon surpassed that of the activities financed by its own Regular Programme budget, and the field programme rapidly evolved from a peripheral activity to become the centre of gravity of the Organization.

**FAO was convinced of the importance of enlightened public opinion in supporting, and at times promoting, government action on world food problems.**

As the years went by, FAO was convinced of the importance of enlightened public opinion in supporting, and at times promoting, government action on world food problems. In 1960 it launched the Freedom-from-Hunger Campaign (FFHC) to focus public attention on the continuing problem of hunger, and to mobilize national and international efforts towards its solution. Promotional by nature, the Campaign enlisted the support not only of governments but also of non-governmental organizations (NGOs), private organizations, religious groups and individual citizens. By 1965, projects estimated at a value of US$400 million had been implemented, mainly through non-governmental organizations. Direct contributions to FAO amounted to nearly US$10 million.

Two general themes ran through FAO's field programme in the sixties: raising the agricultural productivity of developing countries, mainly at the small-farmer level, and optimizing the use of natural resources. FAO's field activities were associated with a major expansion of irrigated agriculture, the introduction of high-yielding varieties of wheat and rice, the efficient use of fertilizers, the control of plant pests and diseases, and the eradication of animal diseases. Most of the projects were supported by comprehensive surveys of land, water, forestry and fisheries resources.

In 1961, under the aegis of the FFHC, FAO established the Fertilizer Programme, "to improve crop production and farmers' incomes through the efficient use of fertilizers". Over the years, its scope has broadened to include all aspects of efficient crop production, such as the introduction of improved varieties, better soil management, weed control and more effective plant protection. The programme addressed small farmers in their own fields and

**FAO's fertilizer programme** sets up thousands of fertilizer demonstrations in more than 20 countries every year. At a site in Zaire, methods for fertilizing row plantings are demonstrated.

provided direct support to marketing and credit facilities. The World Seed Campaign launched by FAO in 1957 culminated in the World Seed Year in 1961 with the objective of stimulating the introduction and breeding of improved varieties as well as the establishment of facilities for the multiplication, certification and distribution of better seed. The First World Food Congress,

**The World Seed Campaign** was an important part of FAO's effort to introduce new, high-yielding varieties and help avert a major food crisis in the Far East. In Mali, boys transplant seedlings of a high-yielding variety of rice.

organized by FAO in 1963, identified 'the Far East, where half of humankind lived on only a quarter of the world's food' to lie at the heart of the world food problem. New high-yielding varieties, particularly of wheat and rice, used in combination with other inputs, made it possible to double yields per hectare and avert a major food crisis in that part of the world.

FAO's locust control activities, started in 1950, were greatly strengthened from 1960 onward by the FAO/UNDP Desert Locust Project, and now cover all principal locust species. The Organization's main role is to strengthen and mobilize support for local bodies, regional organizations and national institutions which carry the main burden of the control operations. Since 1970, FAO has also acted as the main global information centre on the desert locust. The history of locust control over the last 20 years is a success story for which FAO may share the credit.

In 1961, FAO and Unesco embarked jointly on a task that was to take 20 years: the preparation of a Soil Map of the World at a scale of 1:5 000 000. The question 'Is there enough land to feed the world's population?' had never been answered adequately because of the lack of a global inventory of world soil resources. The Soil Map of the World project, undertaken under FAO's Regular Programme, provided the necessary tool for policy-making in the field of land use.

In 1965, FAO launched the Indicative World Plan for Agriculture (IWP) in response to a standing recommendation of the 1943 Hot Springs Conference on Food and Agriculture that countries 'should progressively adjust the allocation of agricultural resources to conform to a long-term coordinated production plan for the best use of these resources on a world scale'. The IWP was controversial. The proposed agricultural strategy for the next 15 years aroused widely differing reactions according to the divergent interests of Member Governments. The Plan

was, however, recognized as 'a pioneering undertaking in the face of great difficulties'. It is this pioneering aspect that appears most significant today. The Plan was, in fact, a forerunner of present concern for sustainability; an attempt at planning for the medium and long term, rather than just for immediate needs.

The 1960s witnessed major achievements by developing nations in their agricultural development. FAO's resources were too limited to claim a central role in bringing about these results, but the Organization takes pride in having made vital contributions in a number of fields. FAO's field work promoted management of resources to include wise utilization - often for new purposes and with new technologies - as well as conservation.

## MANAGING NATURAL RESOURCES AND THE HUMAN ENVIRONMENT: 1972-1986

Concern about the protection of the human environment was greatly increased in the 1960s and early 1970s as new issues came crowding in, ranging from land, air and water pollution to the degradation of the world's resources through soil erosion, deforestation, over-grazing, over-exploitation of fisheries and other abuses.

The whole field was reviewed in 1972 at the United Nations Conference on the Human Environment. FAO played a major role in the Stockholm Conference: of the 108 substantive recommendations made, 36 were either specifically addressed to FAO or included the Organization among the addressees. For the most part, they involved no new lines of work but rather the strengthening of on-going programmes in the areas of habitat and resource conservation; waste disposal and recycling technologies; food contamination control; and the monitoring of environmental problems associated with the use of pesticides and fertilizers.

**The first preliminary bench-mark survey by FAO of the state of natural resources and the human environment was published in 1977.**

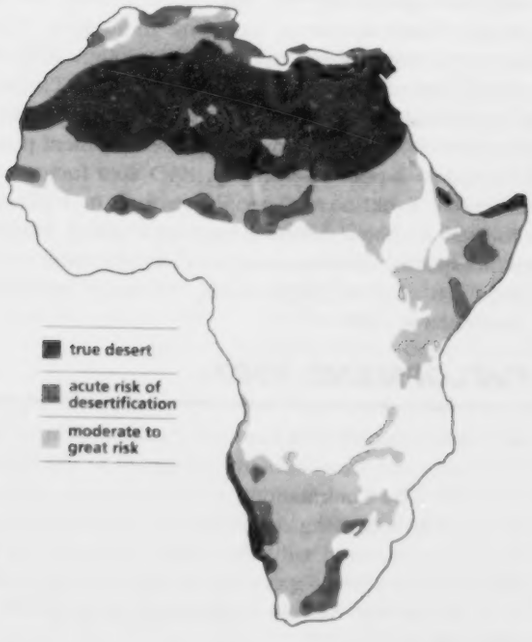
While protecting the environment has long been an integral part of FAO's work, after the Stockholm Conference the Organization established a framework for its programme on Natural Resources and the Human Environment. Its two main components were an assessment of the state of natural resources and their management. The first preliminary bench-mark survey by FAO of the state of natural resources and the human environment was published as a special chapter in the 1977 State of Food and Agriculture review. The survey brought together the data then available - however incomplete - on the main environmental threats to forests and agriculture; it analysed the impact of soil degradation from erosion, salinization and waterlogging; viewed irrigation problems resulting from loss of water and decline in water quality; examined the degradation of grazing land and forage resources, the destruction of forests, the depletion of wildlife, and the impact of over-exploitation of fish stocks; and surveyed threats to the survival of the genetic heritage of crops, forest species, wildlife and fish. The review also examined in some detail the impact on the environment of specific factors such as the use of fertilizers and pesticides, the effects of shifting cultivation in the humid and sub-humid tropics, and the hazards of desertification. This document was the first comprehensive statement of the principal dangers to the environment in FAO's fields of work.

During the 1960s and 1970s, it was realized that productivity and conservation could not alleviate hunger or poverty unless there was also a major improvement in social justice through agrarian reform and rural development. The concept of 'poverty-oriented rural development' coincided with a new

emphasis on increased production by small farmers. The World Conference on Agrarian Reform and Rural Development (WCARRD), meeting at FAO Headquarters in Rome in 1979, adopted a Declaration of Principles and a Programme of Action - the Peasants' Charter - which was to be the base for 'growth with equity and participation'. The Charter was to underlie FAO's approach to sustainable agriculture and rural development, thus ensuring a close link between resource management and the solution of socio-economic problems.

**Desertification** now threatens more than one-third of Africa. FAO mapping projects, including the Soil Map of the World and the World Map of Desertification, have helped identify problem areas and target programmes to stop land degradation.

Despite the greater publicity given to the new generation of environmental problems that emerged in the 1960s, by far the greatest threat to large areas of the globe is still the misuse of their limited soil resources. In order to focus on this problem, the FAO Conference of 1981 adopted a World Soil Charter, originally suggested by the World Food Conference in 1974. The Charter recommends that decisions about land use and management be made for long-term advantage rather than short-term expediency, with land-use techniques selected to achieve improved and sustainable levels of production. The importance of this issue was dramatically illustrated in the study of population-supporting capacities which FAO undertook between 1976 and 1981 in cooperation with UNFPA and IIASA.




Source: The Conservation and Rehabilitation of African Lands (FAO 1990)

In extreme cases, soil degradation can proceed to the point where the land becomes desert, and the impact of desertification - as a result of deforestation, overgrazing, poor cultivation and other processes - has greatly increased in recent decades. A World Map of Desertification, prepared by FAO in cooperation with WMO and UNEP, was submitted to the United Nations Conference on Desertification held in 1977.

FAO has been active in the field of plant genetic resources since the 1940s. However, concern for the preservation of genetic resources really began to mount in the early 1960s. In 1961, FAO organized an international technical meeting on plant exploration and introduction; in 1965 it established a panel of experts on the same subject; and in 1971 it formally proposed the creation of a global network of genetic resource centres. This led to the establishment in 1974 of the International Board for Plant Genetic Resources (IBPGR) to promote further programmes at scientific and technical levels in this field. At policy level, an Intergovernmental Commission on Plant Genetic Resources was established in November 1983 with three main tasks: to monitor the arrangements set forth, to recommend measures that may be necessary to improve the comprehensiveness and efficiency of the global conservation management system, and to advise FAO on its own work programme in crop and forest genetic resources.

From the outset, FAO's work with pesticides has taken into account the threat they can pose to the environment. In 1961, the Organization established a

Committee of Experts on Pest Control whose work, conducted in close cooperation with WHO, has led to the elaboration of a Code of Conduct on the Distribution and Use of Pesticides which was adopted by the FAO Conference in 1985. As early as 1965, FAO organized a symposium on Integrated Pest Management (IPM) which promotes plant protection through various different components of a farming system. Similar concern has been shown for the benefits and hazards involved in fertilizer use, and in 1974 FAO convened an Expert Consultation on the Effects of Intensive Fertilizer Use on the Human Environment.

As a result of the uncontrolled expansion of fishing operations, mainly by industrialized nations, total world fish production began to level off in the 1970s. FAO was instrumental in the elaboration of jurisdiction, within the United Nations Convention on the Law of the Sea in 1982, which recognizes the rights of coastal states to manage their fisheries within 200-mile exclusive economic zones (EEZs), thus ensuring that marine fisheries can be managed properly and effectively. FAO's 1984 World Conference on Fisheries Management and Development produced a World Charter for Fisheries, bringing together for the first time a comprehensive set of guidelines and principles for fisheries management and development.

Throughout the 1970s and 1980s, FAO steadily promoted the role of forestry in watershed management, the control of desertification and the development of improved farming systems based on agroforestry. In 1982 FAO published the first comprehensive survey of tropical forest resources, including an analysis of the rates and patterns of depletion and degradation. In 1985, FAO, jointly with the UNDP, World Bank and World Resources Institute, launched the Tropical Forestry Action Plan which provided an overall framework for investment planning in the forestry sector as well as support to national development plans. In addition to the natural resources aspects of forestry, FAO also focuses on ways to strengthen the sustainable livelihood of people through multiple-use management of trees and forests. A special action programme called 'Forests, Trees and People' addresses this specific component of rural development and is a natural development from an earlier programme, 'Forestry for Local Community Development', launched in 1978.

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## *SUSTAINABLE DEVELOPMENT: 1987-*

International environmental consciousness was boosted by the report of the World Commission on Environment and Development, presented to the United Nations General Assembly in 1987. The Commission's mandate was to propose long-term environmental strategies for achieving sustainable development by the year 2000 and beyond, and to recommend ways by which concern for the environment could be translated into greater cooperation among countries with a view to meeting the needs of the present without compromising the ability of future generations to meet their needs.

FAO has long been concerned with the numerous and interconnected components of what is now called sustainable development. The objectives set out in the preamble to FAO's Constitution, 'raising levels of nutrition and standards of living', 'securing improvements in the efficiency of the production and distribution of all food and agricultural products' and 'improving the conditions of rural populations', are all contained in the various sub-programmes of FAO's overall Programme of Work.

In November 1989, the FAO Conference decided that the Organization should: intensify its interdisciplinary work to ensure the integration of environmental considerations in all relevant FAO activities; give higher priority to the prevention of environmental degradation which affects agriculture, fisheries and forestry; strengthen its cooperation with other organizations of the UN system in these fields; collaborate fully in the preparations for the 1992 United Nations Conference on Environment and Development (UNCED); and respond positively to the UNEP proposal for a joint FAO/UNEP meeting on sustainable agriculture.

The special chapter of The State of Food and Agriculture in 1989 was devoted to sustainable development and natural resource management and outlined strategies for sustainable agriculture, forestry and fisheries. The sections that follow describe how these strategies were further elaborated and how they have been translated into action.

With the cooperation and support of the Government of the Netherlands, FAO organized a Conference on Agriculture and the Environment in 's-Hertogenbosch, the Netherlands, 15-19 April 1991. The Conference provided an opportunity for experts from around the world to review and reallocation-assess various strategies and tools for sustainable agricultural development in the developing world. Participants included senior government officials from 119 countries, representatives of 17 intergovernmental organizations and 20 non-governmental organizations (NGOs), and 26 independent experts.

A noteworthy aspect of the Conference was the open and fruitful exchange of views between experts from a wide variety of backgrounds: senior agricultural planners, administrators in agricultural research and natural resource management, leaders of farmers' organizations in developing countries and representatives of NGOs concerned with environmental protection, alternative forms of agriculture and rural development. Also represented were women's associations, consumer unions, the pesticide and fertilizer industries and both bilateral and multilateral development agencies.

The Conference addressed four main topics related to sustainable agricultural development: issues and perspectives of agricultural growth and sustainability; technological options and research requirements; strategies for sustainable agricultural development in areas with different resource endowments; and criteria, instruments and tools for implementation. The results of the Conference, synthesized in the Den Bosch Declaration and Agenda for Action on Sustainable Agriculture and Rural Development, provide a basis for:

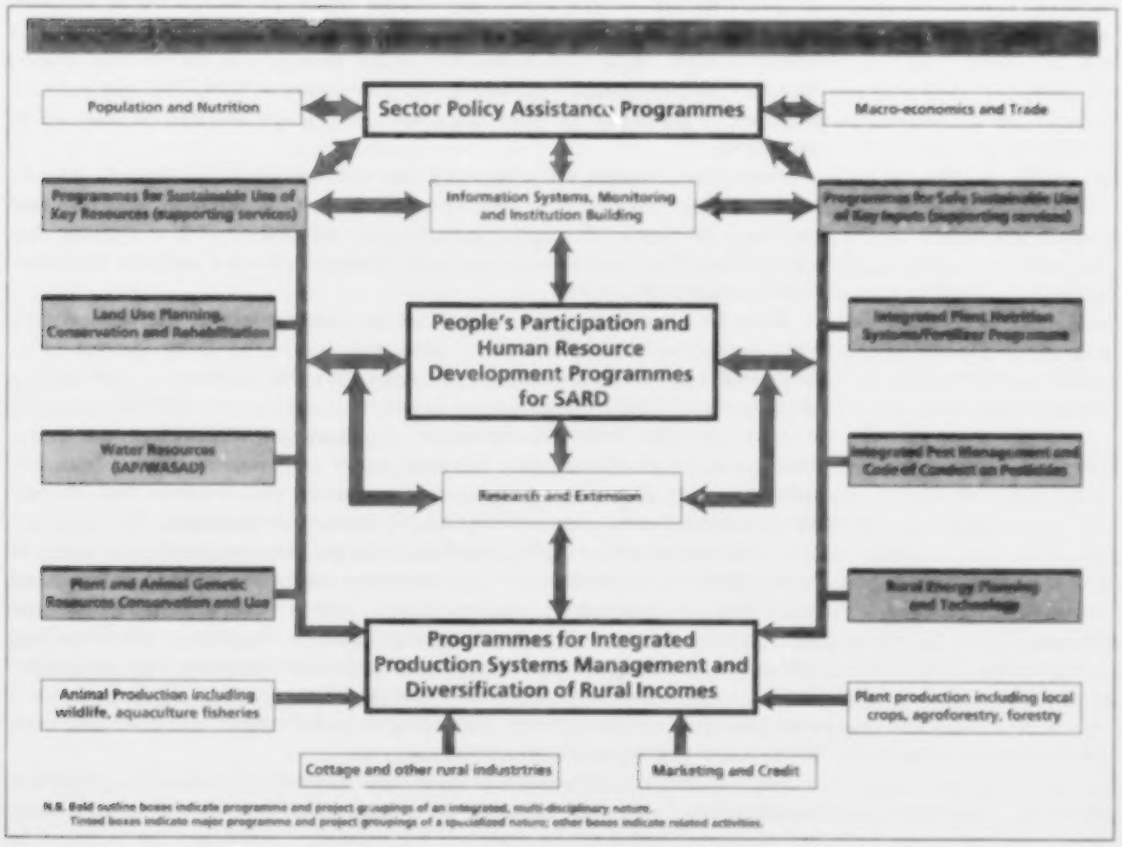
—at national level, a review of agricultural development priorities, policies and plans and of the related implementation tools and programmes;

—at international level, as regards FAO, a means of complementing and reinforcing environmental and sustainability considerations in FAO's agricultural development programmes; and

—also at international level, a broader process of consultation among governments and international organizations with a view to making a substantive contribution to the preparations for the 1992 UN Conference on Environment and Development, in particular 'Agenda 21'.

In many regions, major changes and adjustments will be necessary if

sustainability is to be achieved. This is particularly the case in rural areas with high population densities and on marginal lands where small farmers and landless people are living in extreme poverty with no alternative but to survive


Population and Nutrition
Sector Policy Assistance Programmes
Macro-economics and Trade
Programmes for Sustainable Use of Key Resources (supporting services)
Information Systems, Monitoring and Institution Building
Programmes for Safe Sustainable Use of Key Inputs (supporting services)
Land Use Planning, Conservation and Rehabilitation
People's Participation and Human Resource Development Programmes for SARD
Integrated Plant Nutrition Systems/Fertilizer Programme
Water Resources (SAP/WASAD)
Research and Extension
Integrated Pest Management and Code of Conduct on Pesticides
Plant and Animal Genetic Resources Conservation and Use
Rural Energy Planning and Technology
Programmes for Integrated Production Systems Management and Diversification of Rural Incomes
Animal Production including wildlife, aquaculture fisheries
Plant production including local crops, agroforestry, forestry
Cottage and other rural industrtries
Marketing and Credit
N.B. Bold outline boxes indicate programme and project groupings of an integrated, multi-disciplinary nature.
Tinted boxes indicate major programme and project groupings of a specialized nature; other boxes indicate related activities.

**The Programme Framework adopted by FAO's Conference in 1991 emphasizes the need to coordinate policy and programmes to promote sustainable development.**

at the expense of the limited natural resources available to them.

FAO's determination to address this core problem of rural poverty was reflected in the decision taken by its Conference of 9-28 November 1991 to launch an International Cooperative Programme Framework for Sustainable Agriculture and Rural Development (ICPF/SARD). This Programme Framework is aimed specifically at assisting and encouraging change at international, regional and national level in order to promote and facilitate the sustainable development of agriculture. The main thrusts of this programme framework are presented in the last chapter of this document.

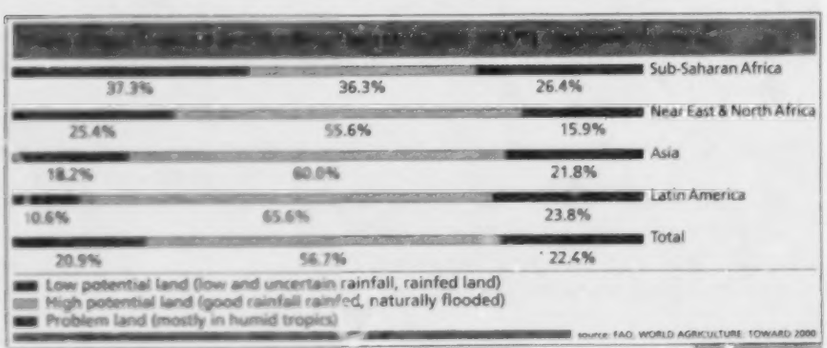
# PART 3:
# FOOD PRODUCTION AND RESOURCE MANAGEMENT

**FAO'S INVOLVEMENT WITH SUSTAINABLE DEVELOPMENT** and the environment reflects a constant evolution of its activities in order to address changing problems in a changing world. During FAO's lifetime, population has increased tremendously, especially in developing countries, and consequently so has the need to produce more food. The unprecedented population growth of recent years has meant, however, that the chances of feeding these additional millions of people - often inadequately - have come to depend largely on short-term applications of technology and an expansion of arable land, the possible side effects of which have not been anticipated or assessed. Pressure on the natural resource base and environmental stress have increased dramatically over the years. Added to the magnitude and urgency of these problems are numerous economic and social issues which have burst upon public complacency. Some of the fields to which FAO has paid particular attention are reviewed below. For ease of reference, activities are reviewed under individual disciplines: however, FAO's involvement, especially at field level, follows an interdisciplinary approach with the fullest possible integration of its various programmes.

## *LAND RESOURCES*

Until recently, our knowledge of the production potential of the world's land resources was rather crude: roughly 20 percent of the land surface was considered too cold, 25 percent too dry, 20 percent too steep or too shallow, 5 percent too wet and 10 percent of too low fertility for agricultural production; 20 percent of the world's lands were estimated to be arable, about half of this being currently in use. This general appraisal left many questions unanswered: Where are the land reserves located? What is their production potential? For which crops are they suited? What are the technologies required for their development? Is their use sustainable? What will be the effects of changes in land use?

It was in order to provide answers to these basic questions that FAO and UNESCO, in cooperation with the International Society of Soil Science (ISSS), decided in 1961 to prepare a Soil Map of the World, at a scale of 1:5 000 000. It was completed over a span of twenty years, and involved soil scientists from all over the world. This global inventory of the world's soil resources proved invaluable at a time when countries were becoming increasingly interdependent for their supplies of food and other agricultural products. Problems of land degradation, and the disparity of production potentials and of population carrying capacities, soon became matters of international concern. The Soil Map of the World was the basis for the preparation of a World Map of Desertification, a methodology for soil degradation assessment and a study of the potential




**FAO's global inventory of land resources** has proved an invaluable tool as countries become increasingly interdependent for their supplies of food and other agricultural products. Information drawn from it shows how finite a resource productive soil really is.

## HOW GOOD THE EARTH?

***Is there enough land available globally to produce the food that will be needed by future populations ?***

***Is there enough land available at national level to allow all countries to attain self-sufficiency in the production of food ?***

Answers to these questions are possible only by a quantifying land resources and evaluating their population supporting capacities. Fundamental to such quantifications is the fact that the ability of land to produce is conditioned by soil and climatic conditions and by the levels of inputs that are being applied - low levels of inputs which prevail in subsistence farming; intermediate inputs which cater for plant nutrition, pest and disease control; or high levels of inputs which are characteristic of intensive agriculture in industrialized countries. In turn, the levels of inputs and land management must be conditioned by the preservation and enhancement of the basic natural resources.

Recognizing these basic principles, FAO and the UNFPA, in collaboration with IIASA, made an estimate of the physical limits of the supporting capacities of lands in developing countries in terms of present and future populations.

While the findings are the result of a broad assessment they do bring to light some important considerations.

—If the people of the world were to live in harmony; if resources were shared; if cultivable land were used in an optimal way, and if there were unrestricted movements of produce, there would be food for all for many years to come without undue stress to the natural resource base.

The reality, however, is very different.

—The Land resources and their potentials are very unevenly distributed both between and within countries, and over large areas the available land resources are insufficient to meet the food needs of populations currently dependent on them or projected to be so in the future.

—In a great number of countries the productive potential of the land is not being achieved because of the low level of inputs. The study identified 55 critical countries whose potential population supporting capacities, at low levels of inputs, were less than their actual present populations.

—In certain countries, production potentials are decreasing alarmingly due to the progressive degradation of the resource base.

When planning for a higher degree of self-sufficiency it is essential that differences in crop production potential are fully appreciated and that land degradation hazards are identified. In some countries, land reserves are such that cultivation can be expanded to meet national requirements and even beyond. In other areas the limits of cultivable land have already been reached or are about to be reached, and most of the necessary increased production will have to come from the intensification of agriculture on land already cultivated. Certain countries with unfavourable soil and climatic conditions may not be able to meet the food requirements of their population, even if the level of inputs were to be optimized. A national assessment of the available land resources is a prerequisite for determining appropriate food policies. Development decisions must be based on reliable knowledge of what is possible and what is not.

With the existence of critical areas in various parts of the world it is clear that food security will also depend on areas with different food-production capabilities complementing each other - a clear indication that the problems of land use and food supply must be tackled at national, regional and global levels and not just within the context of individual countries.

population-supporting capacity of lands in the developing world.

When work on the soil map was in its final stages, FAO went on to link it to data on climate and the growth requirements of specific crops - the Agro-Ecological Zones Project. The objective was to make a first assessment of the production potential of the land resources of the developing world and to provide the physical data base necessary for planning future agricultural development. The study, published in 1981, provided concrete information on the extent of cultivable land, the location of land reserves, the potential of rainfed arable areas, and the areas and crops that would give the highest returns from increased inputs.

The Agro-Ecological Zones Project was followed in turn by a study of the potential population-supporting capacity of the lands of the developing world, carried out jointly with IIASA and UNFPA. The study was based on the fact that physical limits to the amount of food that can be produced in any given area are imposed by soil conditions, climate and the inputs and management levels applied to the land, and gives a general view of the capacity of individual countries to produce enough food to support their populations in the year 2000. Drawing on the Soil Map of the World and the Agro-Ecological Zones Project, the study has identified - in specific geographical terms - a number of policy issues to be addressed at both national and international levels. (See panel, page 24.)

In 1981, the FAO Conference adopted a World Soil Charter to draw attention to the need for optimal land use and the protection of the world's soil resource base. (See panel, page 26.). The Charter calls for a commitment on the part of governments and international organizations to pursue programmes of soil conservation and reclamation. It recommends that decisions about land use and management be made for long-term advantage rather than short-term expediency, and that land-use techniques should be appropriate to sustainable or improving levels of production. Its ultimate value will depend on the extent to which effective action is taken at local and national levels in the countries where soil degradation is a threat. FAO has launched an International Scheme for the Conservation and Rehabilitation of African Lands, designed to strengthen support

**Soil conservation** and anti-erosion techniques are emphasized in FAO training programmes. Inside a family compound in Ghana, an extension worker discusses animal-manure and compost making with a farm woman.

## THE WORLD SOIL CHARTER

***As populations increase, land suitable for cultivation inevitably becomes more scarce. Nearly half the total world population lives in countries that are already using more than 90 percent of their potential arable land. Loss of soil, and of its productive capacity, create increased food dependencies, threats to the autonomy of nations and disparities between countries with different soil resource endowments. This interdependence implies that care for the world's soil resources is an issue of international dimensions.***

***Conscious of this situation, the 21st session of the FAO Conference, in 1981, adopted the 'World Soil Charter' and recommended that the United Nations and international organizations concerned give effect, within their respective spheres of competence, to the Principles set forth below:***

1. Among the major resources available to man is land, comprising soil, water and associated plants and animals: the use of these resources should not cause their degradation or destruction because man's existence depends on their continued productivity.

2. Recognizing the paramount importance of land resources for the survival and welfare of people and the economic independence of countries, and also the rapidly increasing need for more food production, it is imperative to give high priority to promoting optimum land use, to maintaining and improving soil productivity and to conserving soil resources.

3. Soil degradation means the partial or total loss of soil productivity, quantitatively, qualitatively, or both, as a result of such processes as soil erosion, salinization, waterlogging, depletion of plant nutrients, deterioration of soil structure, desertification and pollution. In addition, significant areas of soil are lost daily to non-agricultural uses. These developments are alarming in the light of the urgent need to increase production of food, fibres and wood.

4. Soil degradation directly affects agriculture and forestry by diminishing yields and upsetting water regimes, but other sectors of the economy and the environment as a whole, including industry and commerce, are often seriously affected as well, for example through flooding or the silting up of rivers, dams and ports.

5. It is a major responsibility of governments that land use programmes include measures aimed at achieving the best possible use of the land, ensuring long-term maintenance and improvement of its productivity, and avoiding the loss of productive soil. The land users themselves should be involved, thereby ensuring that all resources available are utilized in the most rational way.

6. The provision of proper incentives at farm level, and a sound technical, institutional and legal framework, are basic requirements for establishing good land use.

7. Assistance given to farmers and other land users should be of a practical service-oriented nature and should encourage good land husbandry.

8. Certain land-tenure structures may constitute an obstacle to the adoption of sound soil management and conservation measures on farms. Ways and means should be pursued to overcome such obstacles with respect to the rights, duties and responsibilities of land owners, tenants and land users alike, in accordance with the recommendations of the World Conference on Agrarian Reform and Rural Development (Rome, 1979).

9. Land users and the broad public should be well informed of the need for and the means of, improving soil productivity and conservation. Particular emphasis should be placed on education and extension programmes and training of agricultural staff at all levels.

10. In order to ensure optimum land use, it is important that a country's land resources be assessed in terms of their suitability at different levels of inputs for different types of land use, including agriculture, grazing and forestry.

11. Land having the potential for a wide range of uses should be kept in flexible forms of use so that future options for other potential uses are not denied. The use of land for non-agricultural purposes should be organized in such a way as to avoid, as much as possible, the occupation or permanent degradation of good-quality soils.

12. Decisions about the use and management of land and its resources should favour long-term advantage rather than short-term expediency which may lead to exploitation, degradation and possible destruction of soil resources.

13. Land conservation measures should be included in land development at the planning stage and the costs included in development planning budgets.

The World Soil Charter further lists the Guidelines for Action required by the acceptance of the above Principles, both by governments and at the international level.

FAO has extended its cooperation for the implementation of these guidelines in the fields of assessment of land resources, land-use planning, soil management, fertilizer use, conservation and reclamation of land resources.

for work on preventing land degradation and restoring the productivity of degraded lands in Africa. The same methodology could also be applied in other regions.

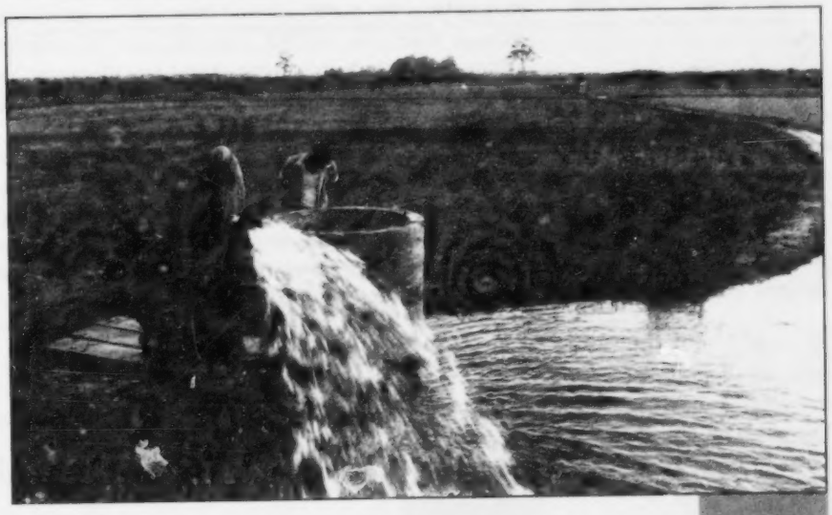
## WATER RESOURCES

Water is an essential component of sustainable agricultural development; its rational development, utilization and conservation are important elements of any development strategy.

For rainfed or irrigated crop cultivation, livestock production and fisheries and forestry development, an adequate supply of good-quality water is essential. However, the most prominent role of water resources in agricultural development is in irrigated agriculture. During the past four decades, irrigated agriculture has provided a major part of total food production. By the mid-1980s, 36 percent of total crop production came from less than 15 percent of irrigated arable land. However, despite its impressive performance in the past, the future role of irrigated agriculture will have to be examined in the light of emerging economic, environmental and socio-political factors.

Worldwide, the average rate of expansion of irrigation was one percent per year in the early 1960s, reaching a maximum of 2.3 percent from 1972 to 1975. Since then the rate of expansion has decreased and is currently less than one percent per year. There are many reasons for this decline, such as the high cost of irrigation development; the sharp fall in world market prices for major cereals; the comparatively high cost of energy; the limited availability of land and water resources suitable for irrigated agriculture; and the adverse environmental impacts of some irrigation projects. (See panel, page 28.)

One of the main concerns over the declining rate of irrigation development is whether, in view of the dominant role irrigation has played in increasing food production, it will be possible to feed a growing world population if the present decline persists. At the same time, it must be recognized that the amount of fresh water available is finite, and that resolving the competition for this limited resource between the various sectors, such as drinking water supply, sanitation, agriculture and industry, is essential. A strategy to manage the world's water resources on a sustainable basis - 'A Comprehensive Strategy of the Mar del Plata



**Irrigated agriculture** provides a major part of total food production, but irrigation often has hidden costs, including wasted water, waterlogged fields and salinization of land. A pump installed by a small farmers' cooperative in Nepal provides water for drinking and irrigation.

## *IRRIGATION: AT WHAT PRICE?*

**After World War II, irrigated agriculture developed rapidly, resulting in a current irrigated land area of some 270 million hectares. However, since the late seventies, the expansion of irrigation has decreased markedly, and with the growing awareness of the environmental, economic and social problems that are created by many development activities, serious questions are now being raised about past irrigation developments.**

**The overall performance of many current irrigation projects is less than expected. Inadequate operation, maintenance and management of an increasingly scarce water resource contribute to many socio-economic and environmental problems. Of major concern is the rapid rise in groundwater which can lead to depressed crop yields, waterlogging, salinity and a host of water-borne diseases. It is not unusual to find that 60 percent of the water diverted or pumped for irrigation never reaches the crops. The cost of providing this water is high, and when more than half is wasted, the cost per unit may be doubled.**

**By far the most significant economic and environmental loss stems form waterlogging and salinization of irrigated lands. It is estimated that on a global basis about 20 to 30 million hectares of irrigated lands are severely affected by salinity and that an additional 60 to 80 million hectares are affected to some extent.**

**The quality of water available to agriculture is as important as the quantity because poor quality water not only reduces crop yields, but can also reduce land productivity and create environmental hazards. Many irrigation developments have suffered in this way. Two common sources of poor-quality water are farm drainage water and untreated sewage effluents. These sources carry significant chemical and biological hazards and have often been the cause of acute and chronic illness in both rural and urban populations.**

**Equally important has been the impact of agricultural practices on water quality. Excess plant nutrients in surface runoff, and deep percolation from both irrigated and rained areas, have contributed to water pollution, leading in particular to high levels of nitrates, eutrophication of surface water bodies and the growth of aquatic weeds in canals and watercourses.**

**It is evident that despite its commendable contribution to food production, past irrigation development has in some instances been achieved at considerable cost, and that approaches to water management and irrigation development need to be geared more consciously to sustainable development and more effective use of finite water resources.**

Action Plan for the 1990s and Beyond' - was adopted by the UN Committee on Natural Resources in 1991. On this basis, an International Action Programme on Water and Sustainable Agricultural Development (IAP-WASAD) was developed by FAO in collaboration with relevant UN organizations and Member Nations (1990).

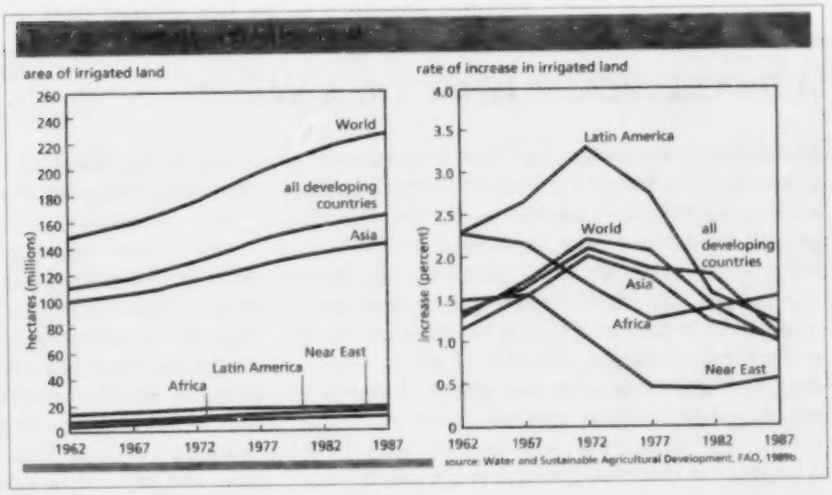
The International Action Programme recognizes the importance of a holistic approach to water resources in order to meet global food and agricultural needs. It calls for integrated development of irrigated and rainfed farming, livestock, fisheries and agroforestry, and emphasizes the importance of water and soil conservation and environmental protection. In terms of crop production, the IAP-WASAD gives priority to increased production from lands that have already been developed through improved water management and other complementary agronomic practices. The Programme identifies five priority areas for concerted action: water use efficiency; waterlogging, salinity and drainage; water quality management; small-scale water programmes, and scarce water resources management.

The ultimate objective of the IAP-WASAD is to assist developing countries in

planning, developing and managing their water resources on an integrated basis to meet present and future needs of agricultural production, and to this end the Action Programme will assist national governments and regional institutions in setting priorities for the use of water and land resources, in updating their current policies and strategies, and in developing and implementing programmes to translate those policies into action.

As a first step, at the national and regional levels, country and regional missions are being undertaken to develop costed, targeted and scheduled programmes in the Lake Chad Basin (a sub-regional mission which includes Cameroon, Chad, Niger and Nigeria), Indonesia, Egypt, Mexico and Tanzania. These missions will be expanded to cover other countries and sub-regions as the Programme develops. At the global level, a planning exercise has been carried out for the implementation of the Programme up to the year 2000, and this includes quantitative targets for development and their costs.

It is hoped that IAP-WASAD, within the broad framework of the United Nations Mar del Plata Action Plan, will meet the challenges of the 1990s and beyond to secure the food and agricultural needs of the world population while protecting and conserving water resources and the environment.




**Irrigation development** has diminished in most regions of the developing world since the early 1970s. Major factors in this decline include the limited availability of land and water resources and the adverse environmental impacts of some irrigation projects.

## EFFECTIVE USE OF INPUTS

### *Plant nutrients*

Like any other system that produces outputs, agriculture also requires a number of inputs in order to achieve sustainability. At the very least it is necessary to replace the nutrients removed by harvested crops. However, even this basic requirement is not being met in many African countries where current mineral fertilizer use is less than 10kg of nutrients per hectare.

FAO carried out a study of nutrient depletion in Sub-Saharan Africa (38 countries) in order to assess the net removal of nitrogen, phosphorus and potassium from arable land in 1983 and in the year 2000. The conclusions are alarming: total input minus total output is negative in each country the net removal of nutrients in 2000 is estimated to be higher than in 1983 in each

country and the inherent soil fertility is being mined continually.

Under traditional systems of agriculture such as shifting cultivation, plant nutrient removal was balanced by periods of fallow when nutrients removed from the field were replaced by recycling, weathering and grazing animals. However, the ever-increasing demands made by rapidly growing populations have caused the widespread breakdown of this system of natural replenishment to the point at which it is no longer sustainable, and alternative nutrient management systems are now essential on most cultivated lands.

In FAO's soil management and fertilizer use programmes, priority is given to the most efficient use of inputs, including: efficient fertilizer use; balanced fertilization; integrated plant nutrition systems; fertilizer supply and the economics of fertilizer use, and fertilizer supply and aid-in-kind through the International Fertilizer Supply Scheme.

Thirty years of Fertilizer Programme experience have shown that the loss of soil fertility due to continuous plant nutrient mining by agricultural activities without any adequate replenishment poses an immediate threat to food production. On the other hand, in some areas environmental hazards are caused by prolonged, unbalanced and sometimes excessive application of mineral fertilizers. These problems can be addressed by using the crop residues and manures accessible to the farmer, combined with a supplement of mineral

## *'AGROCHEMICALS': WHAT'S IN A NAME?*

Many people are increasingly concerned about the potentially harmful effects of chemicals in agriculture. Problems have indeed arisen from the use, or rather the misuse, of some chemical compounds, especially those that are toxic, and in this context the use of the term `agrochemicals' is misleading. It generally lumps together pesticides and mineral fertilizers. The former are biocides - designed to destroy or control insects, fungi or weeds - while fertilizers are composed of nutrients which are essential for plant growth. It is imperative that this distinction is made if misjudgment on the application of `chemicals' in agriculture is to be avoided. It is preferable therefore not to use the term `agrochemicals' or at least not to use it without specifying the products concerned. Actually, the term `mineral fertilizers' - meaning manufactured fertilizers - is to be preferred over `chemical fertilizers'. Since all fertilizers are `chemical', whether they are of mineral or organic origin, natural or manufactured.

In consultation with appropriate United Nations agencies and other organizations, FAO has developed a Code of Conduct on the Distribution and Use of Pesticides (1990). A covenant is now being prepared for the good use of fertilizers, thus making the necessary distinction between the two major groups of chemicals used in agriculture.

Environmental effects of fertilizers may be both beneficial and hazardous, and their actual impact depends less on the fertilizers themselves than on the amounts and on the way they are applied. Where detrimental effects are observed, they are usually due to overdoses or to improper use, which may be corrected by improved management practices. It must be noted that the amounts of fertilizers, both mineral and organic, used in developing countries are relatively low. The local excesses that occur in some industrial countries should not be allowed to prejudice their increased use in the developing world.

Both the code on pesticides and the covenant for good fertilizer include definitions of the terminology being used. The nature and the usage of agricultural `chemicals' vary considerably, and it is incumbent on those in agriculture to do everything possible to reduce or eliminate potential hazards, including those arising from the use of loose terminology. `What's in a name' can make all the difference when it comes to decision-making.

fertilizers, to replenish the plant nutrients removed by the crops. Consequently, FAO actively supports integrated plant nutrition systems (IPNS), an approach that is economically viable, environmentally sound and popular with farmers.

The basic concept of IPNS is to make full use of all available plant nutrient sources, organic (including biological nitrogen fixation) and mineral, in an integrated approach. Within the IPNS concept, mineral fertilizers are used in an economic and environmentally sound way. Fertilizer use efficiency is optimized through good management practices leading to balanced availability of all plant nutrients. The cropping system, rather than an individual crop, is the focus of attention for IPNS.

Given the seriousness of plant nutrient depletion in developing countries, especially in Africa, and the importance of maintaining soil productivity for agricultural development and food security, FAO's Commission on Fertilizers at its Eleventh Session recommended the creation of an International Programme for Sustainable Development of Soil Productivity as a framework for the development of national strategies for conserving and regenerating soils. A 'Covenant of Good Fertilizer Practices' is also in preparation. (See panel, page 30.)

### *Plant protection*

Plant protection makes a major contribution to sustainable agricultural development, and FAO has a number of inter-related activities in this field:

—plant quarantine, which deals with international regulations to prevent the spread of noxious organisms;

—regulatory activities, such as the International Code of Conduct on the Distribution and Use of Pesticides which, with the 'Prior Informed Consent' (PIC) clause provides guidance on the international trade in, and use of, pesticides;

—support for the development and implementation of plant protection activities;

—migratory pest control activities in emergency situations; and

—integrated pest management (IPM) programmes to develop and promote cost-effective and environmentally sound pest control measures.

Since its inception, FAO has been involved in the strengthening of plant quarantine services in developing countries in order to help them meet the requirements of the International Plant Protection Convention (IPPC) of 1951. Activities include the provision of financial and technical assistance, international consultancies in plant quarantine and related fields, the training of staff, and the provision of equipment and reference materials. Information on pest outbreaks and quarantine requirements is provided through the FAO Plant Protection Bulletin and other publications. Quarantine activities are coordinated with the regional plant protection organizations established within the framework of the IPPC. With the advent of the Uruguay Round of Multilateral Trade Negotiations, GATT has identified FAO as the depository of the IPPC, to be the international

organization responsible for removing unjustified barriers to international trade in plants and plant products. In association with the regional plant protection organizations, FAO is now engaged in a joint programme to harmonize principles and procedures in pest risk assessment.

An important element of the FAO pesticide programme is the establishment and adoption of internationally harmonized procedures and standards. The FAO Panel of Experts on Pesticide Specifications, Registration Requirements and Application Standards has formulated such procedures and standards, which are one of the most effective ways of reducing misuse.

FAO has also taken the lead in the development of an International Code of Conduct on the Distribution and Use of Pesticides. This Code, adopted by all FAO Member Countries during the 1985 Conference, has been endorsed by industry and the various environmental organizations. The Code gives detailed advice on appropriate practices for the safe and effective use of pesticides. It is supported by a set of guidelines on matters such as registration and control of pesticides, efficacy data, environmental criteria, residue data, packaging and storage, good labelling practices, disposal of waste pesticides and containers, and personal protection for those working with pesticides.

## *THE LOCUST PLAGUE*

FAO's Locust Control Programme commenced in 1952, and was originally focused on coordinating international action against the desert locust, then in a state of plague in the Arabian peninsula. A major development in 1960 was the first UNDP project, an inter-regional project involving some 30 countries aimed at extending and strengthening national, regional and international action through the FAO-supported Desert Locust Information Service, ecological and operational research, support to field research stations, and training (fellowships, study tours and seminars). During the 1960s and 1970s support was provided to regional organizations concerned with the monitoring and preventive control of the African migratory locust, the red locust, the Central American locust and, in the latter decade, with the quelea bird problem in Africa. In 1974-75 major international assistance to combat grasshopper emergencies in the Sahel was coordinated by the specially created Office for Special Relief Operations (OSRO). In 1978 a short-lived desert locust plague attracted considerable governmental and IGO assistance mobilized and coordinated by FAO.

The return of near-normal rains to much of Africa from 1985 led to the plagues of desert locusts and brown locusts, swarms of african migratory locust and red locust and large infestations of planthoppers in the Sahel. The Emergency Centre for Locust Operations (ECLO) was established to mobilize and coordinate the massive assistance (over US$300 million) provided to meet these emergencies, which were met almost entirely using chemical pesticides. This operation aroused environmental concern and a recognition of the need to develop alternative strategies less dependent on chemical pesticides.

Current and future activities include running the Desert Locust Information Service and establishing desert locust control units in the Sahelian countries; promoting and field testing pesticides that are highly specific to locusts and grasshoppers and therefore of minimal danger to non-target organisms; carrying out studies on the eco-toxicological aspects of currently used locust pesticides; finding and developing biopesticides bases on naturally occurring pathogens (fungi, protozoa, etc.); developing a programme to contain and eventually dispose of obsolete and unwanted pesticides; developing improved methods of pesticide delivery on to target organisms; training in management of migratory pests and co-sponsoring with UNDP a programme to develop non-chemical methods of locust and grasshopper control.

The Organization is actively engaged in helping its Member Countries to establish and strengthen their plant protection services. Support concentrates on defining and describing the essential tasks and attributes of national plant protection services, advising on organization and management, providing operational guidelines, and training scientific and technical personnel.

Facing emergency situations has been one of FAO's major contributions to the sustainability of crop production and its earliest effort in this field was its involvement in locust control. This plague, known since biblical times, has now been checked thanks to international cooperation and the catalytic and coordinating role of FAO. The results obtained illustrate FAO's comparative advantage in conducting large-scale ventures with regional scope. (See panel, page 32.)

Integrated pest management (IPM) is the leading principle for all FAO plant protection activities because it contributes directly to the sustainability of agriculture. Since 1967, an FAO/UNEP Panel of Experts on Integrated Pest Management has been providing advice on ecologically safe pest control practices, reviewing the principles and application of IPM, and promoting joint research and action programmes. Under its auspices, the Global Programme for

## *INTEGRATED PEST MANAGEMENT (IPM)*

Integrated pest management has been defined as 'the pest management system that, in the context of the associated environment and the population dynamics of pest species, utilizes all suitable techniques and methods in as compatible a manner as possible and maintains the pest populations at levels below those causing economic injury' (FAO/UNEP Panel of Experts on IPM, First Session, 1967).

Since its adoption, IPM has become the basis of all FAO plant protection activities because it contributes directly towards the achievement of sustainable agriculture.

While recognizing the widespread benefits derived from the Green Revolution, it should be recognized that the rapid increase in yields was accompanied by a massive increase in the use of agricultural inputs. Pesticides, in particular, were indiscriminately used in many countries, with widespread negative impacts on the environment, the health of farmers and consumers, production costs, the ecological balance of pest populations, and the resistance of pests to pesticides. This situation caused alarm amongst governments and farmers, and an analysis of the problem during the 1960s and 1970s led to the development of alternative and more sustainable pest management strategies. These included the 'best mix' of natural control measures (resistant varieties, cultural practices, biological control, etc.) and a need-only-based use of selective pesticides. This mix should be technically defined for each specific agronomic situation and its implementation should be supported by appropriate policy and legislative measures.

Numerous benefits accrue from the implementation of IPM at field level. IPM-trained farmers are better managers of their fields, grow a healthy and more stable crop and use less pesticides, thereby saving money while reducing environmental contamination and health problems. At national level, benefits include reduced hard currency expenditure on the import of pesticides; reduction or abolition of subsidies; better agricultural production in terms of quantity and quality, and an improved planning and monitoring capacity within the implementing system (from policy to extension to farmers).

The FAO Global Programme, which started in 1982, focused originally on pesticide over-use, for example in rice production in Asia. Now after ten years' experience in IPM implementation, FAO promotes this approach as a pest control strategy that is economically viable for farmers and governments, safe for human health and the environment, and an essential component of any sustainable agricultural system.

the Development and Application of IPM in Agriculture was started, supported by UNEP and implemented by FAO. This led to donor-funded activities, of which the ongoing programme for IPM of rice in Asia and IPM of cotton in Sudan are examples. (See panel, page 33.)

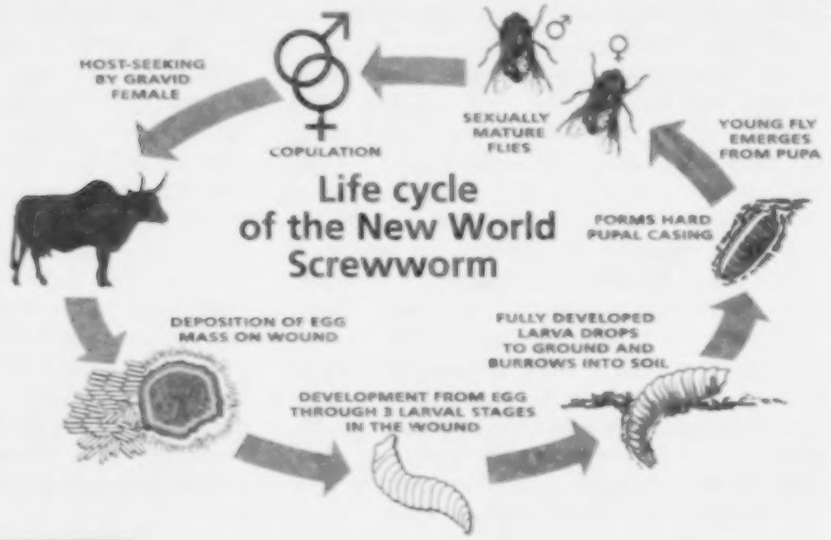
### *Animal health*

A viable livestock sector is an essential prerequisite to achieving optimum sustainable agriculture in the majority of developing countries. Animals contribute to farming systems through the provision of protein and animal products, the provision of manure, as a source of wealth, and perhaps most importantly as draught animal power.

Infectious and parasitic diseases of livestock are especially relevant in developing countries where they influence agricultural settlement and farming practices, often to the detriment of the environment. To counter this influence, FAO's work in animal health concentrates on two main areas: alleviation of emergency disease epidemics; and development of long-term prevention and control programmes. The latter activity forms an integral part of any national development towards conservation-based and sustainable agricultural production.

Control measures, particularly for parasitic and vector-borne diseases, have in the past depended on the use of pesticides which, if improperly used, have adverse affects on the environment and on non-target species. In recent years, FAO has emphasized the development of strategies and technologies that minimize dependency on chemical control without reducing the efficiency of animal health activities. Three examples are the Sterile Insect Technique (SIT) to eradicate screwworm, the development of attractive bait systems for tsetse fly control and eradication, and strategic dipping to control ticks and tick-borne diseases.

Starting with a trial on the island of Curacao in 1952, SIT has been used progressively to clear the United States and Mexico of the New World screwworm, a damaging pest to livestock and also a threat to humans and wildlife. The technique involves the saturation of infested areas with sterile


HOST-SEEKING BY GRAVID FEMALE
COPULATION
SEXUALLY MATURE FLIES
YOUNG FLY EMERGES FROM PUPA
Life cycle of the New World Screwworm
FORMS HARD PUPAL CASING
DEPOSITION OF EGG MASS ON WOUND
FULLY DEVELOPED LARVA DROPS TO GROUND AND BURROWS INTO SOIL
DEVELOPMENT FROM EGG THROUGH 3 LARVAL STAGES IN THE WOUND

**The Sterile Insect Technique (SIT)** is both highly effective and environmentally benign. An area is saturated with sterile males, whose mating with fertile females produces no live eggs, disrupting the life cycle of the pest. After about 12 life cycles, eradication is achieved.

males. After about twelve life cycles, eradication is achieved. Screwworm was discovered in Libya in 1988, and by 1990 had infested an area almost as large as the Netherlands. An internationally-funded programme of eradication was undertaken in 1990 by FAO, and within one season it had accomplished its purpose, thus averting the threat of screwworm spreading through Africa and the possible decimation of the continent's livestock and wildlife. While the technique is costly, it has been shown to be highly effective and advantageous from the environmental point of view. No chemicals are involved, and so no residues are left in the environment. Furthermore, because of the biology involved and the aim to achieve eradication, no problems of evolving resistance occur.

Tsetse flies, of which there are some 23 species, are the vectors of trypanosomiasis, a disease that is a major cause of death and sickness in both humans and livestock throughout Sub-Saharan Africa. Large sections of the continent remain uninhabitable as a result of their presence, with consequent overstocking and degradation of tsetse-free areas. Traditional methods of control involve the use of insecticide spraying to eliminate the vector, and regular chemotherapy of livestock. Research in recent years, much of it pioneered and supported by FAO, has led to the development of environmentally benign methods of tsetse eradication and control. The development of these methods has necessitated a comprehensive investigation into the stimuli that attract the fly to its host, and this has led to the construction of odour-baited devices sufficiently attractive to entice a considerable proportion of the population to an insecticide-treated surface. Progress has been such that most economically important species can be reduced by more than 90 percent in less than six months using 4-25 devices per square kilometre. FAO is involved in an important UNDP-funded project to promote the use of trypanotolerant livestock in 19 countries of West and Central Africa. The wider use and further improvement of livestock breeds able to tolerate infection is a useful and environmentally-sound method of helping to resolve the problem. Strategic plans have therefore been developed for several countries, and breed improvement programmes for cattle and sheep are being undertaken.

Ticks and tick-borne diseases are a significant constraint on livestock production throughout the developing countries. FAO's regular and field programmes have achieved a better understanding of the population dynamics of the pests and this has resulted in improved control strategies and a marked reduction in the use of acaricides. Studies on tick ecology in East, Central and Southern Africa have confirmed that in many climatic zones the frequency of application can be reduced from once or twice weekly to 12-18 treatments per year. In some areas, the use of acaricide has been reduced by between 60 and 70 percent, thus minimizing the risk of environmental contamination and the possibility of residues persisting in meat and milk. This approach, while suppressing and controlling tick populations, also ensures that livestock can develop and maintain endemic stability.

Recently it has been demonstrated that insecticide-treated cattle are also effective in the control of tsetse populations. Plans are being formulated for an integrated approach to tsetse and tick control using this method as this would further reduce the already low levels of pesticides being used.

In collaboration with other organizations, FAO has also supported investigations into the development and testing of vaccines against tick-borne diseases. This has reduced dependency on insecticides still further, as dipping needs to be undertaken only during the season of peak challenge in order to

minimize losses from high tick burdens.

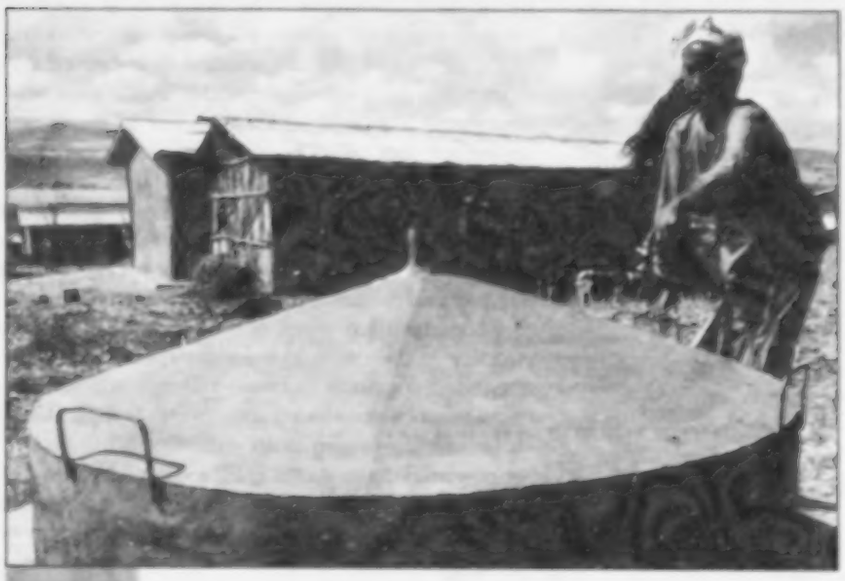
Animal health programmes will inevitably result in an increase in livestock populations which may, in certain areas, increase the negative environmental effect of overgrazing. To counteract this, sustainable conservation-based activities must be integrated into national and regional development programmes.

### *Energy for rural development*

Industrialized and developing countries alike have energy supply and demand structures that are unsustainable, volatile and environmentally dangerous. Developing countries, still lacking the energy inputs necessary to achieve their development goals, are faced with high-priced and unreliable energy supplies. Industrialized countries, with only 20 percent of the world's population, consume more than 80 percent of the fossil fuels produced, and are facing even worse air pollution problems. Developing countries are facing the difficult challenge of increasing energy demands at a time of increased environmental consciousness. This challenge is particularly difficult in rural areas where the majority of people rely on firewood, agricultural residues, and animal and human power to cover their subsistence energy needs, and where only meagre amounts of energy are available for income-generating activities.

**The dual role of rural areas as producers and consumers of energy demands an approach that integrates economic, social, financial and technological issues.**

The inter-relationships between energy, development and environment are complex when dealing with subsistence-level energy consumption. The dual role of the rural areas as producers and consumers of energy demands an approach that integrates economic, social, financial and technological issues. As rural energy is in many cases the main source of energy for the urban sector as well, it is vital that its sustainability is maintained. However, energy policies, infrastructure and technologies are largely non-existent in the rural areas of developing countries. While the transport, industrial and urban sectors have relatively well-developed energy data bases, management skills and institutions, the rural areas continue to be isolated from the main energy development efforts. Their energy data are poor and unreliable, and energy pricing policies are non-existent: usually no single institution is responsible for energy decision-



**Small-scale technologies** utilizing renewable energy can contribute to a more diversified and sustainable energy base, while reducing reliance on wood that frequently leads to deforestation and erosion. An Ethiopian woman turns on the gas at a biogas digester that fuels the kitchens of 10 households.

making, and the prevailing low level of economic activity makes public and private financing difficult.

FAO is working towards a new approach to rural energy problems that will take into account the small-scale nature of energy requirements, the lack of any systematic approach to energy management, and the absence of institutional infrastructure that characterizes the rural sector. Whilst in industrialized countries and in the 'modern' sectors of many developing countries, the energy-environment relationship is well understood, policies and taxes are being set in place to reduce $CO_2$ and other emissions, and high-tech options are becoming available, the situation is drastically different in the rural areas of developing countries. Here, the low level of economic activity and the present energy supply and demand patterns require completely different approaches. Under present trends, the development gap between the modern and rural sectors will undoubtedly grow, largely due to energy-related issues.

In response, FAO is helping countries to integrate their rural and agricultural sectors into the modern development thrust of national energy development, which includes incorporating environmental considerations of both local and global scale. Activities are geared to developing methodologies, formulating strategies and promoting field activities that will improve energy management and energy investment decisions and lead to environmentally sound development. In collaboration with national energy and agricultural authorities, FAO has promoted programmes geared to the more effective utilization of wood energy, agricultural residues, biogas, solar energy and biomass energy conversion while a number of technical cooperation networks on wood energy, rice-husk gasification, biogas, renewable energy and energy efficiency in agriculture promote the exchange of experience and the transfer of technology among countries. Publications and training activities complement these field programmes.

The activities promoted by FAO are leading to a more systematic assessment and management of energy for rural development and to better-coordinated energy, agriculture and environmental plans. They take advantage of decentralized energy technologies based on a mix of conventional and renewable energy sources, and of small-scale technologies utilizing biomass, solar, wind and other renewable energy. Through these activities FAO is working towards a transition from the present reliance on wood, and animal and human power, to a more diversified and sustainable energy base. An Interdepartmental Working Group on Energy, with members drawn from the Agriculture, Forestry, Fisheries, and Economic and Social Policy departments draws together the multidisciplinary expertise of the Organization and guides its work.

## BIOLOGICAL DIVERSITY

### *Plant genetic resources*

World interest in plant genetic resources has grown rapidly in recent years because they represent both the raw material used in the production of new cultivars - either through traditional plant breeding or the use of biotechnology - and a reservoir of genetic adaptability that acts as a buffer against harmful environmental change. It is recognized that the erosion of these resources severely threatens world food security and that there is an urgent need to conserve and utilize plant genetic resources as a safeguard against an

unpredictable future. (See panel, below.)

Plant germplasm must be protected for the use of future generations, and its availability for scientific purposes ensured through equitable agreements at international level. Since its inception, FAO has been actively concerned with the conservation and utilization of plant genetic resources. Between 1961 and 1981, four technical meetings were held on this subject and an Expert Panel on Plant Exploration and Introduction, established in 1965, held six meetings up to 1974 when the International Board for Plant Genetic Resources (IBPGR) was set up. A crop genetic resources unit was established in 1968.

As the number of activities related to plant genetic resources increased, the need was recognized to establish ways of coordinating intergovernmental action at the global level. It was also recognized that to be successful, any system to be developed should benefit all participants and take fully into account the rights of the donors of germplasm, funds and technology and the obligations of the

## THE GREEN REVOLUTION

The 'green revolution' started in the early 1960s with the development of new varieties of rice and wheat, and the concurrent promotion of irrigation, pest control and plant nutrition contributed to the impressively high yields obtained with the improved seeds. Predictions of unprecedented world famine were confounded. Instead, food production in Asia, not including China, increased by an average of 3 percent per year between 1961 and 1985.

The main benefit of the green revolution was the hugely increased availability of the two major staple cereals: more than half the developing world's area of rice and wheat cultivation is now sown with the new varieties. However, when the implications of the green revolution were analysed, a variety of opinions emerged. Some highlighted the spectacular increases in production and the possibility of double cropping in favourable environments with early maturing varieties. In the 1960s and 1970s, the area sown to wheat increased by 25 percent, but production doubled. Both South and Southeast Asia doubled rice production over a 20-year period, since the 1960s.

Other analysts voiced concern about the way the benefits of the revolution were being distributed. It was argued that larger farms and better endowed environments benefited more than small farmers, and that the new varieties required levels of external inputs that small farmers could not afford. Impact studies have shown that there were differential adoption rates but that overall, both large and small-scale farmers benefited from the new high-yielding wheats and rices. Obviously, attaining the genetic yield potential required a proportionally higher supply of plant nutrients. It should be realized, however, that long-standing economic and social discrepancies can hardly be solved through the introduction of an agricultural technology. It is the responsibility of decision-makers, through public policy, to help farmers irrespective of the size of their holdings to benefit from improved farming practices and to ensure access to the necessary inputs.

In 1990, India's wheat harvest was 50 million tonnes from 23 million hectares; at 1960 yield levels, the country would have required about 40 million hectares of additional arable land. In countries with high population pressure, such as India, increasing production through horizontal expansion is no longer possible. Even in countries where land reserves are still available, the expansion of cultivation is often at the expense of forested areas or marginal lands.

The wide distribution of selected semi-dwarf varieties has resulted in a narrowing of the germplasm base of the rice and wheat crop, and in response FAO actively promotes the collection, conservation and use of primitive cultivars and landraces. Its activities in this field are well recognized and the effectiveness of ongoing programmes should ensure the preservation of biological diversity.

recipients. As a result, in 1983 FAO developed a Global System on Plant Genetic Resources, with a mandate to ensure the safe conservation of plant genetic resources, and to promote their unrestricted availability and sustainable utilization. The system covers the conservation (*ex situ* and *in situ*) and utilization of plant genetic resources - genes, genotypes and genepools - at molecular, population, species and ecosystem levels. To date, 128 countries are formally part of the Global System, either as members of the Commission or adhering to the International Undertaking, or both.

The first four sessions of the Commission reached consensus on a number of issues which are likely to influence for many years to come the policies, programmes and activities of FAO and other organizations dealing with plant genetic resources. A major breakthrough was the resolution on farmers' rights (see panel, below) and an agreed interpretation of the International Undertaking that recognized the rights of both donors of technology and donors of germplasm to be compensated for their contribution through the simultaneous recognition of the rights of both plant breeders and farmers. Other components of the Global System include the development of international agreements and arrangements to facilitate the conservation and use of plant genetic resources, and the preparation of two codes of conduct: a code for collection and transfer of plant germplasm, submitted to the Twenty-Sixth Session of the FAO Conference; and elements for a code of conduct on biotechnology as it affects the conservation and use of plant genetic resources.

Within the context of the Global System, FAO is establishing:

—a network of *ex situ* base collections;

—a network of *in situ* conservation areas with emphasis on wild relatives of cultivated plants;

—a Global Information and Early Warning System on Plant Genetic Resources;

## *FARMERS' RIGHTS*

Plant genetic resources, particularly those endemic to centres of origin and diversity, are a common heritage of humankind, to be preserved and made freely available for use.

The philosophy of FAO's programme on crop genetic resources is based on a 'farmer-to-farmer' approach. It starts with the collection of landraces and primitive cultivars which have been domesticated and developed by farming communities over millennia, and continues through conservation, genetic improvement and seed production. This germplasm is used to develop new and improved varieties which are returned to farmers with a view to increasing their production potential.

Considering that most plant genetic resources, in the form of wild plants and old landraces, are to be found in developing countries, the contribution of their farmers should be duly recognized and rewarded. The FAO Conference in 1989 therefore adopted a resolution endorsing the concept of farmers' rights, assuring them of full benefits and supporting the continuation of their contributions. These rights are vested in the international community as trustees for the benefit of present and future generations.

FAO considers that conservation and utilization of plant genetic resources should be closely linked. It is therefore a basic objective to strengthen the human, technical and economic capabilities in developing countries to utilize germplasm through plant breeding and seed production, including the use of up-to-date biotechnologies.

—a periodic report on the state of the world's plant genetic resources; and

—a Global Plan of Action on Plant Genetic Resources.

Following approval by the Twenty-Sixth Session of the FAO Conference in November 1991, it is proposed to convene the Fourth International Technical Conference on Plant Genetic Resources in late 1993 or early 1994. The draft of the first State of the World report and a global plan of action on plant genetic resources will be prepared within the framework of this conference and will also take into consideration UNCED's resolutions and recommendations on this subject. The Global Plan of Action will include a general budget as well as priority programmes and projects for local, national, regional and international activities, and projects to be implemented by appropriate agencies and organizations, including FAO and IBPGR. The financing of these projects and activities through an International Fund on Plan Genetic Resources will permit the implementation of farmers' rights.

### *Forest genetic resources*

Work on forest genetic resources in FAO was intensified after the establishment in 1969 of a Panel of Experts on Forest Gene Resources. As the living tree is generally longer-lived than seed or pollen, and as regeneration of collections when germination or storability drops presents enormous practical problems, conservation of genetic resources of forest trees and shrubs is generally done through living collections (*in situ* and *ex situ* conservation stands). Thus, seeds and other propagating materials are generally stored in the country of origin or by the country using the materials, on a short- or medium-term basis only.

Among the studies currently being coordinated by FAO are those on the compatibility of *in situ* conservation of forest genetic resources and forest management for the production of goods and services; and on the possibility of a global network for the conservation *in situ* of forest and plant genetic resources. A complementary study deals with new possibilities in the use of *ex situ* conservation in forestry, with special reference to recent developments in biotechnology. Ongoing collaboration with national institutes in some twenty developing countries covers all aspects of genetic resource work, with some bias in the past few years towards the collection of dry-zone woody species for conservation and evaluation purposes, and the development of methodologies of in situ conservation in developing countries.

### *Animal genetic resources*

Animal genetic diversity is part of the earth's natural heritage, and there are both scientific and economic arguments for the conservation of the resource.

FAO, in cooperation with other organizations (e.g. UNEP and the European Association of Animal Production) has been developing methods aimed at preventing the loss of genetic diversity. A global data bank has been established and will be used to identify breeds at risk, and training programmes for both data bank and gene bank activities have been carried out.

Many countries throughout the developing world have placed their indigenous livestock populations at risk through programmes of exotic breed

importation and/or crossbreeding. Rarely has adequate attention been given to determining realistic and optimum breeding objectives prior to embarking on breed improvement programmes. Objectives followed by breed improvement schemes are often totally inappropriate to the existing or available infrastructures. It is proposed therefore to assist selected Member States in the planning and initiation of realistic breeding strategies so as to avoid inappropriate breed replacement/dilution programmes. In addition, improvement programmes for selected indigenous breeds are planned. These will take place in the normal environment, and for some endangered breeds, where appropriate, in situ preservation will be developed. Cryogenic storage will be used to maintain diversity of some breeds, and it is envisaged that DNA libraries will be developed in the longer term.

## FOOD RESOURCES

### Food contaminants

Food and feed safety are important issues in sustainable development. The hazards from environmental contamination have increased significantly in recent years because of accelerated industrialization and urbanization, intensification of agricultural production, increased use of storage and centralized processing, and distribution and handling methods. Microbiological contamination of food has always been recognized as a serious problem. Chemical contamination, on the other hand, is a more recent and growing phenomenon. It affects both food and feed products and may originate from industrial chemicals and wastes, pesticides used in agriculture, toxic metals such as lead, cadmium and mercury from processing and/or packaging, seed disinfectants and fungicides, and certain drugs and chemicals added to feed.

FAO assists countries in the prevention and control of food contamination through monitoring and surveillance programmes within the framework of national food quality control systems. Support is given in the development of improved food systems and in ensuring the safety and quality of food supplies.

Close collaboration is maintained with WHO in programmes to maintain food quality and safety. These programmes are regularly reviewed by the FAO/WHO Codex Alimentarius Commission, an intergovernmental body of 138 Member Governments which develops international food standards and codes of practice and recommends maximum permissible levels of certain additives and contaminants. A similar service is provided by the FAO/WHO Joint Meeting on Pesticide Residues which evaluates pesticides and recommends residue limits that are consistent with good agricultural practices and acceptable from a toxicological viewpoint.

A joint FAO/WHO/UNEP Food Contamination Monitoring Programme has designated collaborating centres in 39 countries to serve as focal points for national contamination monitoring programmes. The centres provide data on residues of selected pesticides and other organochlorine compounds, heavy metals and aflatoxins, which are stored in a computer system at the WHO centre in Geneva. Data reports by country and by contaminant are published regularly.

To maintain the physical and nutritional quality of food during shipment, storage and distribution, increasing use is being made of selected food additives. Concern about the safety of these chemicals led to the establishment in 1956 of the joint FAO/WHO Expert Committee on Food Additives, which evaluates

substances used in food processing or present in food as a result of contamination. The Committee also provides specifications relating to the identity and purity of food additives, and establishes acceptable levels for their use in food.

The contamination of food by mycotoxins and other fungal toxins continues to be of international concern, especially in tropical and semi-tropical countries. Sustained storage of products such as grain, groundnuts, copra and cottonseed meal create ideal conditions for fungal attack. Many developing countries have suffered considerable financial losses through the refusal of importing nations to accept shipments of products affected by aflatoxins.

In response to this problem, FAO helps developing countries to implement regulatory measures governing the export of food products and to establish proper controls over their storage. It also recommends contamination limits for both imported and domestic food supplies. In Asia, Africa and Latin America, workshops have been held to discuss the extent of mycotoxin contamination, its implications for trade and economic recovery, and associated health considerations. Practical training in laboratory identification and estimation of aflatoxins has also been carried out, supported by publications such as Mycotoxin Surveillance and Training in Mycotoxins Analysis in the FAO series, Food and Nutrition Papers.

FAO provides 25 laboratories in developing countries with reference standards for aflatoxin and other contaminants in order to improve analytical performance and reliability. Suitable practices are recommended for the prevention of mycotoxins (especially aflatoxins) in standing crops, harvesting, storage, transport and processing. While these recommendations serve to minimize the risk of contamination, methods are also proposed to remove, inactivate and destroy mycotoxins so that some of the food may be salvaged.

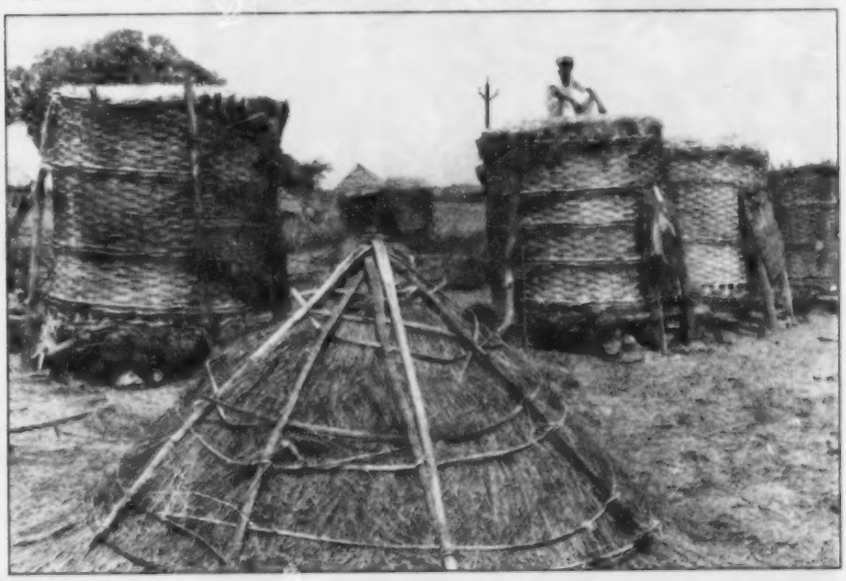
### *Maintaining food quality*

Street foods are ready-to-eat foods and beverages prepared and/or sold by vendors in streets and other public places. They often represent a major part of the diet of urban populations. Poor hygiene in the preparation and sale of street foods is a continuing problem: in fact, a recent cholera epidemic in Latin America was linked in part to street foods and the water used in their preparation. FAO has carried out a number of projects in Africa, Asia, and Latin America and the Caribbean to evaluate the problems associated with street foods and to assist governments in developing programmes to improve their quality and safety.

Food quality improvement must begin at farm level and must be regarded as an indispensable element of the global approach to improving the post-harvest system. Contrary to what is generally thought, action taken to improve grain storage and pest control is insufficient to prevent food loss and quality deterioration. To ensure optimum storability of food, attention must be paid to each link in the post-harvest system, from physiological maturity to marketing.

Quantitative and qualitative food losses occur at various stages, from harvesting through processing and marketing right up to consumption. FAO assistance to developing countries for the prevention of such losses aims at promoting a self-sustainable national post-harvest system. Institution-building activities, aimed at creating awareness and establishing a coherent institutional framework, complement training activities and aim to develop a cadre of

qualified technicians at national level. FAO also provides assistance in the identification of key constraints in the post-harvest system, as well as in the development of appropriate technical solutions. Technical Cooperation among Developing Countries (TCDC) is promoted to facilitate inter-country transfer of appropriate post-harvest solutions while support to the extension services



**Reducing post-harvest losses** can significantly increase effective agricultural production, without increasing external inputs or encroaching further on fragile ecosystems. In India, FAO's Action Programme for the Prevention of Food Losses works to improve storage cribs by raising them higher above the ground and ventilating them.

ensures the effective delivery to the farming community of the technology packages developed. A major target for post-harvest assistance is the small farmer, responsible for most food production in developing countries, who most heavily depends on stored reserves. Emphasis here is placed on women, who play a key role in post-harvest activities.

One of the major objectives of field activities in the post-production sector is to strengthen national capabilities to prevent unacceptable food crop losses caused by biological agents. Emphasis is placed on training in appropriate pest-control practices, storage, preventative measures, sanitation and disinfestation operations. Support is provided for the creation and management of village-level stocks and cereal banks. Also, technologies for improved storage, handling and drying of crops are introduced. Another important measure is the promotion of small-scale community processing centres to prevent post-harvest losses at village level and to provide processed food products for semi-urban and urban areas. Besides cereals, the latter two activities cover other food staples such as legumes, and perishables such as roots, tubers, plantains, fruits and vegetables. Preservation of these crops enhances the quality of diet for poor people and contributes to the stability of supply.

Irradiation techniques are a means of controlling insect infestation in grains, retarding deterioration in food quality, or destroying disease-producing micro-organisms in some fruit. A joint FAO/IAEA/WHO Expert Committee issues safety clearances for low levels of irradiation and, under the auspices of an International Facility for Food Irradiation Technology, in cooperation with the Netherlands, conducts training courses in irradiation techniques for commodities of interest to developing countries.

**Rural marketing** centres and cooperatives provide farmers with outlets for their crops. In an open-air market in Ivory Coast, customers check for the best prices on locally grown produce.

### *Improving food marketing*

Support in the areas of food marketing i provided through direct assistance t marketing boards aimed primarily a strengthening their management capacit and systems. This includes upgrading thei planning and logistics organization an improving the storage arrangements fo public foodgrain stocks. These often include food reserves, which contribute significantly to stability and hence to food security. A more responsibility for food marketing i taken on by the private sector, it i important that markets are as open a possible in order to maximize competitio and facilitate the flow of food to area experiencing shortages. Support is provide to government marketing departments usually in ministries of agriculture, to hel them develop their national capacity t determine appropriate marketing policy an infrastructure. FAO's field projects also support the development of rural marketing centres and the strengthening of the role o cooperatives. In attempting to improv financial services in rural areas, fiel projects aim at improving farmers' access t credit so as to give them the opportunity t purchase farm inputs which contribute directly to increased production.

In recent years, the concept of marketing extension has been introduced Extension services often lack marketing skills and are rarely able to advis farmers on how best to market their products. Food security aims coul therefore be better served if extension officers were more market-oriented.

## FEED AND GRASSLAND RESOURCES

In animal production, the focus is on increased and improved use of fee resources, particularly at the level of the smallholder and with special emphasi on feeds produced on the farm. FAO's programmes distinguish groups o countries having similar ecological conditions and production systems: the semi arid region of South America; the sub-humid regions of East Africa; the Magre countries; the wet monsoon and humid tropics of Southeast Asia; the Highlan Himalayan region; the Andean Altiplano; and the arid region of Patagonia Nitrogen-fixing forage legumes, and fodder trees and shrubs are of prim importance in all these zones. Wherever possible, emphasis is given to th adaptation of local management systems to changing conditions, and to th maximum exploitation of local technical knowledge.

In the semi-arid and arid zones, the emphasis is on improving fodde conservation, fodder trees and grazing systems. In the humid and sub-humi

areas, the main emphasis is on providing high-quality feed adapted to local production systems, often in the form of nitrogen-fixing legumes, to complement the poor pasture and coarse roughage which form the basis of livestock feed. Forage seed production is a major aspect. Networks or regional working groups are used to ensure contact between national institutions and between countries with similar ecological systems.

**The improvement of vast areas of natural grasslands requires considerable use of applied ecology.**

The improvement of vast areas of natural grasslands, often in semi-arid areas, requires considerable use of applied ecology. The sowing of fodder and pasture within agricultural lands entails critical crop choices and requires considerable agronomic skills. Many attempts have been made to improve animal production from extensive grazing in the traditional areas of Africa and the Near East, but few have been successful and even fewer have had a positive effect on the vegetation cover of the grazing lands. Reseeding is costly and unless the management faults that brought about the degradation can be rectified, the results of this and other 'range rehabilitation' activities will be ephemeral. Production of fodder on adjacent agricultural land, while it may have positive effects on overall animal production, rarely reduces the grazing pressure on commonly-managed grazing land.

Fodder trees and shrubs are expensive to install and require careful management if they are to last. Their potential role in animal feeding in semi-arid lands should be positive but has not yet been proved in the context of traditional livestock husbandry. Various systems of enclosing grazing lands under group or other systems of ownership have been tried in many countries with the aim of limiting stock numbers as well as improving production. In the short term, they frequently reduce the problem in one area while intensifying it somewhere else. In the medium term they usually break down in times of stress when stock from outside are brought in to the area.

FAO has an established long-term programme based on the improvement of grazing resources in arid and semi-arid regions of the world, with major emphasis on Africa and the Near East. Strategies include an integrated approach to grazing-land development that involves all the components in the agricultural sector subject to periodic droughts, with emphasis on the participation of the local population.

The FAO programme on sown pasture and fodder is largely but not exclusively concentrated on the humid and sub-humid areas, the major emphasis being placed on the intensification of productivity leading to a more integrated livestock/cropping type of agriculture. This is becoming increasingly necessary with growing demographic pressure on arable land. In temperate regions, emphasis is given to the mountain regions of the Himalayas and Andes where improved grassland technology is needed not only to improve fodder supplies but also to protect the fragile watersheds. In the wet tropical region activities are concentrated on smallholder systems in Southeast Asia and Central America and the Caribbean.

In all these programmes, much of the work is done by cooperating national institutions. Important themes are the demonstration of improved grassland and fodder crops; the enhanced use of legumes, including trees and shrubs as fodder; the training of technical staff in applied techniques; and the use of fodder production in dairying. The use of nodulated legumes as a cheap and safe source of nitrogen for both the pasture and livestock is a mainstay of the work.

***Sustainable production systems***

Over 400 million rural households are involved in agricultural production in the world, more than 90 percent of them situated in developing countries. These farm households are the principal decision-makers with regard to the use of crop and grazing land for food production, water for irrigation, energy for farm operations, and trees for fuelwood and construction. In the overall management of their production systems, farmers employ a complex mixture of traditional and new practices, the latter acquired through contacts with government research

## *LISA OR BISA?*

The term LISA - low-input sustainable agriculture - was coined in developed countries in the light of the environmental hazards caused by high or, more often, excessive inputs of fertilizers and pesticides. Not only do these overdoses constitute a threat to the environment, but they also represent a costly production factor. It is against this background that 'low inputs' were equated with 'sustainable agriculture'. In the case of industrialized countries, 'low inputs' actually means a reduction of the high levels current in 'modern' agriculture. It is misleading, however, to apply this same concept to agriculture in developing countries, where corresponding input levels are generally low. Here sustainability problems are generally those of depletion rather than of pollution. Loss of soil fertility results from a continuous mining of plant nutrients without their adequate replenishment. The age-old method of shifting cultivation - which made it possible to grow crops for a few years on nutrients derived from burning the forest - can no longer meet the demands of the present populations, let alone those of future generations.

Clearly, maximum use should be made of local resources such as crop residues, green manures and biological nitrogen fixation, but it must also be realized that residual organic matter cannot replace the harvest that is removed. Furthermore, large areas of acid soils in the tropics are inherently poor, so that even the organic matter they produce is very low in plant nutrients. Therefore, a combination of organic materials and mineral fertilizers, sufficient to replenish the plant nutrients removed by the crops and to enhance soil fertility, should be promoted.

FAO is actively supporting the development of Integrated Plant Nutrition Systems (IPNS) as an approach that is economically viable, environmentally sound and conducive to the urgently needed increases in food production. Naturally, IPNS has to be 'tailored' specifically to the resources available in different agro-ecological conditions, and also adapted to various farming systems. It would be preferable, therefore, to advocate BISA - a balanced inputs sustainable agriculture - rather than LISA. The term 'balanced' refers to an adequate and feasible combination of organic and mineral inputs, taking into account the availability of organic material and labour. 'Balanced' also points to the need to ensure a supply of the three basic plant nutrients, N, P and K, since organic material supplies only a substantial amount of N.

Integrated Pest Management (IPM) is another key component in sustainable agricultural systems. By keeping the use of chemical pesticides to a minimum and applying principles based on pest ecology (e.g., pest life cycles, predator/prey relationships), methods of cultivation and production can be adjusted so that farmers reduce their costs while avoiding the risks of excessive use of pesticides.

In the developing countries, LISA is often broadened to LEISA (low-external-input sustainable agriculture), to take account of the cost of purchased inputs which small farmers can afford rarely. The solution is not, however, to deny farmers the use of inputs. Such an attitude would be comparable to solving the problem of the hungry by recommending an even lower food intake. It is the task of public policy to create the economic motivation, and the infrastructure, necessary to give people access to the inputs they need.

and extension services, international organizations and NGOs, and the private sector. Encouraged or discouraged by government policies and regulations, market conditions and price signals, farmers are making short- and long-term management decisions on crops to be grown, livestock to be kept, technologies to be adopted and investments to be made.

During the past three decades, production practices and systems have undergone profound changes, spurred on by the rapid increase in food demand, rural and urban population growth and technological change. While most production systems, ranging from shifting cultivation and pastoral systems to crop-based or mixed crop/livestock systems, are inherently sound and sustainable on an individual basis, their rapid multiplication and intensification may impose stress on the wider agro-ecosystem in which they are situated. An under-standing of complex production systems in relation to farm-household-environment relationships in areas with different resource endowments and agro-ecological conditions is important in the planning of sustainable development. (See panel, page 46.)

Since the early 1980s, FAO has focused on the development of agricultural production and farming systems in a holistic manner, and to this end a farming systems analysis and development approach was adopted in the Regular Programme and field work. Initial activities were targeted on the development of methodologies and procedures for the implementation of this approach in field projects and programmes. Such methodologies include: production and farm data analysis, rapid rural appraisal techniques, analysis of indigenous production practices, the economics of cropping systems and the preparation of long-term multidisciplinary programmes for on-farm technology testing. Emphasis is also given to training, through guidelines for seminars, informal workshops with universities, and the implementation of regional training programmes. Existing methodologies will be further developed to enable household and production systems to be integrated with multiple family objectives that include profitability, equitability and sustainability. A new focus is given to the integration of traditional and modern farm and crop management practices and to the reduction of risks through on-farm and off-farm diversification of rural incomes, particularly in fragile ecosystems such as mountains, semi-arid areas and forests.

## FOREST RESOURCES

### *Environmental factors*

Much of the public concern about conservation of the environment and the depletion of natural resources focuses on large-scale deforestation, wasteful logging practices and excessive fuelwood consumption, particularly in the developing countries. In both developed and developing countries, the damage regularly caused by fire is recognized as a major threat to forests and the environment, especially in semi-arid tropical and Mediterranean areas. In developed countries environmental problems in forests are largely due to air pollution and acid rain, although more recently the threat of climate change has added a new dimension. (See panel, page 48.)

Natural forests are essential to life and human well-being. Being renewable, and for as long as they are conserved and managed sustainably, they can satisfy the large, diverse and often conflicting demands which people make on them. They play a crucial role in regulating the atmosphere and the climate. They

absorb solar radiation, influence the hydrological cycle and moderate local climates. Forest cover on steep and fragile mountain slopes moderates surface run-off and soil erosion, thereby reducing downstream siltation of reservoirs, irrigation systems and fish habitats, and the threat of flooding of croplands and homes. Similarly, trees and woody vegetation play a major role in arresting land degradation and controlling wind erosion and desertification in dry zones.

Forests are major stores of carbon. They provide raw material for income-earning activities by local and national communities and a variety of products

## *FORESTRY AND CLIMATE CHANGE*

A build-up in the atmosphere of the so-called greenhouse gases has been clearly documented over recent decades and a doubling of carbon dioxide ($CO_2$) has been predicted by the middle of the twenty-first century. This may cause the earth's climate to become significantly warmer, with the major changes predicted to occur at higher latitudes. Changes in rainfall and rainfall patterns may also be expected.

The primary source of $CO_2$ build-up is the combustion of fossil fuels, which account for approximately 5.4 billion tonnes of carbon per year. However, deforestation, which is eliminating considerable amounts of biomass, particularly in the tropical forest areas, also contributes to this build-up. The amount of $CO_2$ thus released is estimated at 1.6 billion tonnes per year. On the other hand, natural forests, plantations, and trees in non-forest areas are capable of storing carbon as woody tissue. Considerable amounts of carbon may be absorbed through reforestation and afforestation and by increasing the stocking and production of existing forests. Worldwide, atmospheric carbon is estimated to be increasing by approximately 3 000 million tonnes annually. The natural atmospheric pool of carbon is estimated at 700 000 million tonnes. Although it would, in theory, seem feasible to capture a significant portion of the yearly increase through accelerated tree planting, capturing the full excess would require an unrealistic input of some 500 million hectares of high-yielding plantations in the immediate future. The initial cost would be some US$200-500 000 million. As a measure of comparison, about 1.1 million hectares of plantation were established in 1980 in the tropical world, and although the rate of planting has increased significantly during the 1980s, it falls far short of the total area needed to capture the excess carbon in the atmosphere.

It is clear that forestry can contribute substantially to capturing $CO_2$, and it is therefore important to diminish the rate of deforestation; increase the rate of afforestation/reforestation; improve the management of natural generation of trees and shrubs; improve the management and productivity of existing forests, including intensive protection against fire, diseases and insect pests; and increase the conversion of mature wood to durable wood products.

FAO's contribution in this field lies first and foremost in its role as coordinating agency for the implementation of the Tropical Forests Action Programme (TFAP) the general aim of which is to strengthen and harmonize international cooperation in tropical forestry. It constitutes a forestry response to climate change at national as well as regional and global levels. It promotes the sustainable management of tropical forests, afforestation/ reforestation and tree planting, all of which are key components in limiting the amounts of carbon dioxide present in the atmosphere.

In its publication 'Climate Change and Global Forests' FAO reviewed the status of knowledge as of 1989. It is recognized that predictions on future climate change merit concerted action by the world community viz. dissemination of information on the role of forests as sinks and sources of carbon dioxide; protection and buffering of forests and trees against destruction; potential effects of climate change on the distribution and productive capacity of forest ecosystems, and adoption of global and national strategies aimed at a better scientific understanding of the processes involved. However, it is also recognized that massive reforestation for the sole purpose of sequestering $CO_2$ cannot be justified at the present time.

used by forest dwellers and rural people for food, fuel, fodder and medicines. At the same time, they conserve genetic resources and important wildlife habitats. An important consideration of natural forest management is to ensure that selected areas are preserved on a scale that can maintain biodiversity and take into account the interests of forest dwellers.

FAO regularly monitors world forest resources. In 1980, in collaboration with UNEP, the Organization carried out an assessment of tropical forest resources. A further global assessment is just being completed with 1990 as a reference year, and preliminary results show the rate of tropical deforestation to be 17 million hectares per annum, thus confirming it as a major environmental problem.

In addressing the impact of forestry on the environment as well as the influence of the environment on forests, FAO concentrates on the environmental influences of sound forest management and utilization. Forest management includes a range of interventions from complete protection to management of timber and other forest products in three basic production systems: natural forests, plantation forests and agroforestry. FAO focuses on two main areas. The first entails providing assistance to Member Countries in the management of their tropical high forests, with special attention to sustainability and multiple use. In support of this, the Organization has published reviews of management systems in Africa, Asia, and Latin America and the Caribbean. FAO has also published guidelines for the integration of genetic resource conservation into productive forest management systems. A second area is the management of woodlands and shrublands in dry zones, with people's participation and the integration of livestock activities.

Plantation forests serve primarily to rehabilitate degraded lands and to

## *DESERTIFICATION*

The consequences of uncontrolled land use are often disastrous. Deprived of their vegetation cover, the shallow soils on tropical hillsides may be stripped away during a single rainy season. Nowhere is environmental stability more critical than in the arid and semi-arid regions of Asia, the Middle East and Sub-Saharan Africa. In these dry lands the heavy demand for fuelwood, the overgrazing of livestock and the clearance of marginal lands for dry farming of cereals leads inevitably to extension of the desert.

Reforestation projects using drought-resistant tree species can stabilize and enrich impoverished soils, while shelter, shade and improved water retention can create conditions suitable for sustained agriculture. The trees provide fodder for livestock, fuelwood and building timber, and even cash crops. Training and extension activities associated with the conservation measures encourage the gradual settlement of nomadic rural populations.

FAO has helped many countries to develop strategies for combating desertification. Projects on sand dune stabilization have been undertaken in southern Morocco, coastal Senegal, Mauritania and Somalia. Particularly important is the assistance provided to the eight countries of the Interstate Committee for Drought Control in the Sahel (CILSS) in their major programme of creating village fuelwood plantations in that drought-ravaged region.

An important aim in arid zones is to encourage greater diversification of production, particularly for the provision of fodder and wood, through integrated agro-sylvo-pastoral systems. The large number of FAO-assisted rangeland management projects operating in North Africa and the Near East provide a wealth of new information and experience in this respect. This is being passed on through workshops and training courses to develop skills in fodder, fuelwood and shelterbelt provision, and in many other aspects of arid-zone management and integrated rural development.

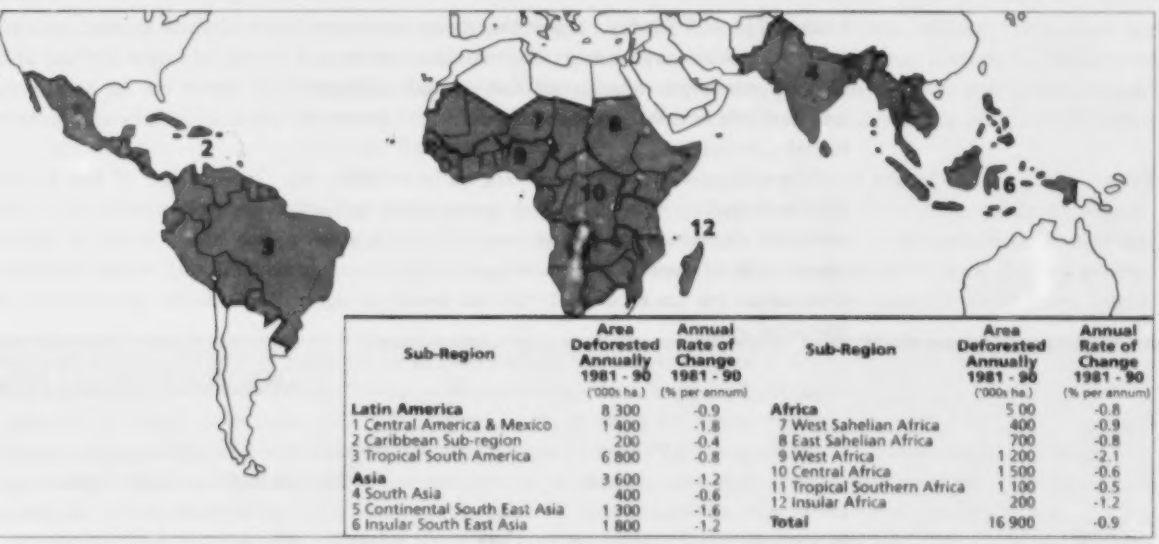
produce wood for fuel and industrial purposes. While they may have a low amenity value, well-planned and managed plantations, making use of suitable species matched to the requirements of sites and with the objective of serving clearly defined markets, can have a positive impact on the environment. In arid and semi-arid areas special attention is devoted to combatting desertification (See panel, page 49.)

### *Forestry for people*

Agroforestry and tree planting outside forests can help to restore degraded lands, rehabilitate salt-affected land, stabilize sand dunes by tapping moisture and nutrients in the deep soil layers, provide windbreaks and shelterbelts, help protect and improve crop yields, and provide sources of fodder, fuelwood and green manure. In agroforestry, woody perennials are integrated with crops and/or animals on the same land management unit in order to obtain the best returns on a sustainable basis. Other FAO initiatives include provision of seed through genetic improvement work, the installation of seed storage facilities, training and networking, and the introduction of multipurpose species and dryland species particularly in Africa.

One of the essential objectives of sustainable development is the attainment of economic viability through sound land use. Providing employment and income to rural people through sustainable forest exploitation offers a more environmentally sound alternative than clearing the forests for non-sustainable forms of agriculture such as shifting cultivation or cropping on fragile and marginal soils. Pilot studies in tropical countries have demonstrated that closed forests can be managed sustainably for timber and other forest products while maintaining environmental benefits and conserving irreplaceable genetic resources. However, a key factor is the political will of countries to institute effective programmes. Constrained by serious socio-economic and institutional difficulties, many developing countries are unable to support the degree of commitment required. The implementation of the Tropical Forests Action

**Planting trees helps** restore degraded lands and stop desertification. In Bangladesh, schoolchildren participate in a community forestry programme.




| Sub-Region | Area Deforested Annually 1981 - 90 ('000s ha.) | Annual Rate of Change 1981 - 90 (% per annum) | Sub-Region | Area Deforested Annually 1981 - 90 ('000s ha.) | Annual Rate of Change 1981 - 90 (% per annum) |
|---|---|---|---|---|---|
| **Latin America** | 8 300 | -0.9 | **Africa** | 5 00 | -0.8 |
| 1 Central America & Mexico | 1 400 | -1.8 | 7 West Sahelian Africa | 400 | -0.9 |
| 2 Caribbean Sub-region | 200 | -0.4 | 8 East Sahelian Africa | 700 | -0.8 |
| 3 Tropical South America | 6 800 | -0.8 | 9 West Africa | 1 200 | -2.1 |
| **Asia** | 3 600 | -1.2 | 10 Central Africa | 1 500 | -0.6 |
| 4 South Asia | 400 | -0.6 | 11 Tropical Southern Africa | 1 100 | -0.5 |
| 5 Continental South East Asia | 1 300 | -1.6 | 12 Insular Africa | 200 | -1.2 |
| 6 Insular South East Asia | 1 800 | -1.2 | **Total** | 16 900 | -0.9 |

**Forest resource appraisals** are part of FAO's mandate. This map and table, based on data collected for the Forest Resources 1990 Project, give preliminary area estimates for countries lying predominantly in the moist tropical zone.

Programme and the provision of assistance to countries in policy formulation, strategy and planning will help consolidate their capabilities in forest management.

Public and political reaction to forest operations deemed detrimental to the environment is becoming more severe - a tendency evidenced by recent proposals for boycotting the use of tropical wood, and by proposals made in several developed countries to ban imports of tropical timber unless it can be proved to have come from a forest managed on a sustainable basis. However, blanket bans are largely ineffective: they are even likely to aggravate deforestation as local communities and national planners will look for more remunerative alternative land-uses. A better conservation strategy is to increase the economic benefits gained from using the forests and to strengthen the institutional capacity needed to ensure sustainability of productive forest management. Forest products harvesting, transport and processing need not cause serious environmental damage, and can contribute significantly to the pressing and legitimate needs of countries to utilize this natural resource for development. Proper monitoring and control can ensure that appropriate harvesting and road construction techniques are used, and that timely action is taken to regenerate harvested sites. FAO is giving particular attention to ways of improving logging practices so as to reduce waste, environmental damage and loss of the forest's productive capacity.

### *Research and cooperation*

The effects of air pollution and acid rain are so far evident mainly in temperate and boreal forests. It is estimated that almost 15 percent of the growing stock of 17 European countries has been moderately to severely damaged by air pollution and that the decrease in productivity in those forests is related to either location-specific or transboundary pollution. In the first case, notably in the immediate vicinity of polluting industries, there is a clear causal relationship between forest die-back and measurable chemical changes in the environment such as increased soil acidity. Transboundary pollution, a term often used for air pollution that cannot be readily attributed to a specific source, is also leading to measurable

changes in soil acidity. Many European countries have already started nation-wide monitoring systems to discover the extent and trends of forest decline and to gain more knowledge of the causal relationships involved. In addition, national and international legislative action has been taken to control and reduce harmful emissions.

There is an urgent need to greatly expand our knowledge of the forest resource and its values, and to assess more accurately its potential to meet the multiple demands for forest products on a sustainable basis. A much wider application of sound forest management practices is needed and, where feasible, there must be an increased role for trees on agricultural lands, particularly in marginal areas.

FAO has given strength to the concept of sustainable development in its work with other international agencies such as UNEP (forest resources assessment and conservation of genetic resources); the International Tropical Timber Organization (ITTO) (preparation of guidelines for sustainable forest management and plantation development; IUCN (national systems of protected areas and environmental management); and WRI, co-founder of the Tropical Forests Action Programme. Further work is being carried out in FAO to examine ways and means by which environmental and sustainability considerations could be integrated into all stages of the project planning and implementation cycle.

The Tropical Forests Action Programme (TFAP) has become an important means of providing policy advice and planning assistance to developing countries in order to combat forest degradation and to promote sustainable forestry development. The TFAP aims to establish a process through which all interests, public and private, cooperate in the sustainable management and utilization of forest and tree resources with the support of the international community.

### *Sustainable forest use*

Sustainability cannot be achieved without the intimate involvement of other sectors, such as agriculture, if wasteful and unplanned expansion of other land uses onto forest lands is to be avoided. Key policy aspects which require concerted attention are land use and tenure, national financial incentive mechanisms, forest industries development, institutional reforms and people's participation. Local needs for forest goods and services must also be given a much higher priority.

Before more forest land is considered for allocation to agricultural purposes, attempts must be made to increase agricultural productivity on existing farm and range lands and to ensure that sustainable agriculture will be possible on any land that is converted from forest. Governments need to develop land use policies aimed at achieving efficient use of land while striking a balance between environmental requirements and the pressing needs for increased food production and income generation.

**If forest resources are to be used sustainably they must be treated as a capital asset in the national accounts.**

If forest resources are to be used sustainably they must be treated as a capital asset in the national accounts. Government pricing policies must reflect the true value of forest resources, including the full costs of establishing, regenerating and managing the public forest estate. Most developing countries are forced to maximize the use of their land and natural resources to support economic and social development and to pay their debts. In this respect, the potential for environmentally sound use of trees and forests is important. In recent years,

however, governments have tended to neglect the forest industry sector in order to address short-term and more politically expedient concerns. Wherever feasible, the potential for development of appropriate forestry enterprises should be pursued by developing countries at all levels, from small-scale local industries to larger forest industries.

Wild animals are one of the most important direct contributions of the forests to the well-being of local people. Major efforts should be made to assess, manage and utilize these resources with a view to their inclusion in national economic development plans. Forest management should include the application of techniques designed to increase the sustainable yield of meat from forest-

## *WILDLIFE AS FOOD*

With the domestication of animals and the development of settled agriculture, humans gradually moved from complete dependence to partial dependence on wild animals for meat. Nonetheless, in all cultures of the modern world, wherever people eat meat, there is still a significant demand for wild game: in Sub-Saharan Africa, its proportion of total protein supplies is exceptionally high.

There is little information on the nutritional value of traditionally preserved game meat. However, there is evidence that when fresh, game meat compares favourably with domestic meat in terms of mineral, vitamin, fat and protein content. Game meat is leaner and the yield from wild animals is similar to or even exceeds that of domestic stock. Perhaps the most important measure of the local value of game meat comes from studies that have asked people what they value most from forests. Many of those surveyed considered the worst impact of forest conversion to be the loss of game meat in the area.

Many of the species important as food are taken for granted: they are over-exploited and their habitats abused. This leads to local elimination of significant resources. For many, income from hunting is an essential part of a subsistence economy. However, hunting tends to become excessive and requires management if the resource base is to be maintained.

Both domestic stock and wild animals convert vegetable matter to meat, but vested interests invariably favour the former. While the meat production potential of wild animals compares favourably with that of livestock, indigenous animals continue to be deliberately exterminated in favour of livestock. The elimination of wild animals does not, however, lead to optimal utilization of range. Domestic animals are selective in their feeding and not all range plants are utilized. A variety of animals with complementary feeding requirements can be much more advantageous. Thus, suitable mixes of domestic and wild animal species in combined production systems have economic and ecological advantages.

Management systems and technologies should be developed to improve such integration and increase total meat production. Both kinds of meat are in demand, but the additional income for sport hunting and recreation is an added benefit.

In developing countries, attempts to integrate wild animals into cropping systems are rare. Wild animal production can be more easily integrated with tree crops than with large-scale food crops, which replace all existing vegetation, and in the latter case, it is important to maintain suitable wild animal habitats by creating hedges, windbreaks and shelterbelts

Although many governments have resorted to law enforcement to control wildlife exploitation, such laws are commonly disregarded where resources and short-term survival are linked. Conservation for its own sake does not work. There can be no long-term future for wildlife or protected area management where local people are antagonized. Instead, they should benefit from the management of these resources and have a vested interest in their conservation as sources of food and income. The requirements of tourism and meat production need not be mutually exclusive.

based animals. As such an approach could lead to significant improvements in forest development efforts, not only those aimed at commercial production but also those concentrating on conservation of the resource base. FAO is actively engaged in developing the potential of wild animals to contribute to rural economies and to improving the nutrition levels of rural people. (See panel, page 53.)

If rural people do not perceive that sustainable forest management is to their advantage, no amount of government decrees or plans will achieve the desired effect. People's participation in decision-making and management, and in the sharing of benefits, should therefore be given high priority in forestry development. FAO has carried out a wide variety of studies and demonstration activities to develop participatory approaches and mechanisms for the management, production and utilization of renewable natural resources by rural people themselves. The 'Forests, Trees and People' programme aims at the appropriation of forest and tree-related practices by rural people so that forestry is a real benefit to them, not only through physical benefits but also through environmental and cultural outputs and services.

An important aspect of the contribution of forests to the environment and to people's welfare is the role of trees in urban and peri-urban areas. There is a growing demand in urban societies for forested or tree-covered spaces and FAO, recognizing this need, has included urban forestry in its Programme of Work for 1992/93.

Many environmental concerns related to forestry are local in nature. However, the increased international concern over global environmental issues calls for more action at the international level and on a global scale, by both developed and developing countries. FAO has assisted the international community to reach a consensus on a set of principles for the management of forests. For the present, 'a non-legally-binding authoritative statement of principles for a global consensus on the management, conservation and sustainable development of all types of forests' has been worked out within the framework of the preparatory process for UNCED. These principles will have to be considered alongside those embodied in existing and proposed international agreements, including the International Undertaking on Plant Genetic Resources, the proposed International Convention for the Conservation and Utilization of Biological Diversity and the proposed Framework Convention on Climate Change.

## FISHERIES RESOURCES

The 1984 FAO World Fisheries Conference endorsed a Strategy for Fisheries Management and Development and approved five associated Programmes of Action which now serve as an international framework for fishery management and development. The Strategy provides guidelines for the sustainable use of fishery resources and the protection of aquatic habitats from pollution and other forms of environmental degradation, including those originating from fisheries, especially aquaculture. The Conference also adopted a special resolution calling for international action to protect the fishery resources of developing countries from pollution.

Two major issues are of importance when considering sustainable development and environmental conservation with respect to fisheries: first, the characterization and assessment of the present state of living aquatic resources

**Increased productivity** can help fisheries compete with more destructive uses of coastal lands. At a mariculture research center in India, students conduct feeding experiments on young finfish.

and their environment; and, second, the various technical interventions relevant to the sustainable use of fishery resources and the protection of the aquatic environment.

The combination of population growth and efforts to raise living standards has created stress on the financial, physical and human resources of developing countries. It has often exacerbated poverty and triggered migration to coastal areas. This has led to overfishing and, partly through the introduction of inappropriate technology, contributed to the degradation of the environment. Lakes and rivers have also been altered by human activities, nearly always with negative consequences for fisheries. Water quality has become a major concern in aquaculture. Freshwater fisheries are adversely affected by the lowering of lake levels and drainage of wetlands, and by water extraction, siltation, the construction of dams and the regulation of rivers for navigation and flood prevention.

Coastal ecosystems, such as estuaries, marshes, shallow bays and wetlands, mangroves, coral reefs and seagrass beds, play a major role in the life cycles of many economically important fish species by providing breeding, nursery and feeding grounds: about 95 percent of the world's marine production originates from coastal ecosystems. Their accelerated degradation by land reclamation, drainage, coastal construction and other competing uses now poses a serious threat to marine fisheries.

**Fisheries are generally not the culprit but rather the victim of environmental degradation.**

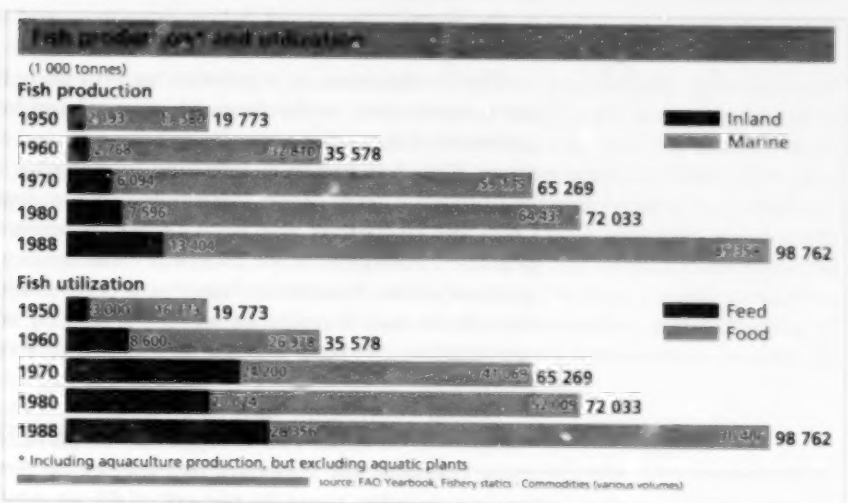
The exploitation of natural resources and habitats is a function of human population size and development, and the trends towards accelerating urbanization, more powerful technology, greater affluence and faster transport are expected to continue throughout the world. Fisheries are, in fact, generally not the culprit but rather the victim of environmental degradation. Controlling coastal development and protecting habitats will, however, often involve painful social and political choices.

The magnitude and pace of the anticipated global climate changes are still

not clear, and it is therefore difficult to forecast their effects on fisheries and aquaculture. Large changes in total marine fish production are not expected, although particular stocks will be affected. Changes in rainfall patterns and river runoff, as well as sea-level rise, will affect life in coastal nursery areas. Tropical upwelling zones, which produce large amounts of fish, might shift polewards by 200 to 700 kilometres and increase in strength. The year-to-year variability of the resources they support may also increase. However, the increased plankton productivity may reduce oxygen levels and lead to anoxic conditions. Financial consequences are hard to predict and it is difficult to initiate major interventions until better forecasts are available. Premature, ill-informed decisions could be costly and dangerous, although there is also a risk in taking no action at all.

Chemical pollution, even at low levels, may influence fish production in numerous ways. They include: reduction of stocks by mass mortality; gradual decline or change in species composition, of fish populations or entire ecosystems; increased occurrence of disease; deterioration of the food quality of fish and reduced growth rates. Seas and land-locked water bodies receive a significant proportion of polluting chemicals via the atmosphere so that effects far distant from the source cannot be discounted.

Nutrient-rich wastes boost primary production in otherwise nutrient-poor seas. They may even enhance fishery resources, although they tend to favour the production of small pelagic fish of low economic value. Such wastes may lead to eutrophication, subsequent oxygen depletion and anoxic conditions in the deeper layers of lakes and stratified seas.




**Fish production** has grown rapidly and has put tremendous pressure on resources. Almost all bottom-dwelling species are already either fully exploited, overfished or depleted.

The uncontrolled cutting of mangroves and the clearing of mangrove swamps for various purposes, including coastal shrimp farming, will destroy the nursery grounds of a number of commercially important marine species and adversely affect those living resources inhabiting the ecosystem. Furthermore, shorelines will be deprived of natural protection from winds and waves, with a consequent increase in coastal erosion.

Fishing modifies the structure, species composition and reproduction rates of both targeted and non-targeted fish stocks. Moderate levels of exploitation remove old, slow-growing individuals and reduce the abundance of large predators, thereby increasing the productivity of the remaining stocks and the sustainable yields. High levels of exploitation reduce large, slow-growing species

to 'commercial extinction'. Although few cases of biological extinction by fishing alone have been documented, uncontrolled fishing can have serious ecological consequences, such as the destruction of coral reefs or sea-grass beds.

Environmental capacity and 'acceptable' levels of impact should ideally be established in advance, since any human activity may irreversibly change some components of the marine environment.

About 13 percent of the world catch of aquatic resources comes from inland waters, half of it from fresh-water aquaculture. Most fisheries are small-scale subsistence or commercial operations. They exploit lakes, rivers, reservoirs and flood-plains in competition with other human activities, and nearly all major enclosed water bodies are now seriously affected by these competing uses. As major controls on inland water environments are exercised by non-fishery users, fishery managers must participate to a much greater extent than at present in the

## *SHRIMP FARMING: A SUCCESS FOR AQUACULTURE?*

One of the highlights in the recent history of aquaculture is the growth in production of shrimp. In tropical coastal areas, using simple earth ponds, tidal or pumped water supplies, local or hatchery-reared seed, and simple fertilization or feeding, a marketable crop of shrimp can be produced in as little as three or four months. Annual yields range from 200 to 500 kg/ha in simple extensive tidal ponds using natural productivity, to upwards of 10 tonnes/hectare in modern intensive systems with artificial feeding, aeration and regular water exchange. Sold on the international markets shrimp is an almost perfect export: it uses basic local resources to bring in foreign exchange. Recognizing its potential, FAO has played a key role in initiating and supporting the industry with inputs in technical development, training, information services and institutional backstopping.

In production terms, the result has been impressive. In 1981, cultured shrimp accounted for 2.1 percent of the total world shrimp harvest, while in 1988 this share had risen to 22 percent. Output in 1988 reached some 450 000 tonnes, corresponding to a farm-gate market value of perhaps US$2.5 billion. Much of this originates in the developing world, particularly in Southeast Asia and Latin America.

As a result of this development, rural coastal land of limited agricultural potential has acquired a new status and value. There are also new prospects for income and employment: traditional brackish water fishpond operators have a new source of income; fishing communities can get involved in catching seed shrimp and broodstock; and farms and hatcheries in rural areas can offer local employment and training for young people. In Southeast Asia, 'backyard' hatcheries have provided excellent opportunities for small family-based businesses whose earnings stimulate their local economies.

However, much of the potential of the industry, not least its current sustainability, is under question. After a decade of increasingly rapid and profitable growth, shrimp farming is facing the consequences of its own unrestrained expansion. Markets are showing increasing signs of saturation, disease losses are occurring as a result of environmental degradation and the widespread clearing of mangrove areas, the erosion of coastal margins, and the salinization of coastal flood plain soils are giving cause for increasing concern.

If shrimp farming is to bring real and continuing benefits to producer countries, means will have to be found to stabilize the industry, increase its efficiency and reduce its adverse impacts. This will require the right kind of market and technical support, planning and regulatory advice, particular care over resource management, and social and environmental assessment. These concerns are already being addressed in current FAO projects in Asia and Latin America, and while support for production continues, the emphasis is shifting more strongly towards ensuring sound, well-structured, sustainable shrimp farming in the future.

planning of the integrated use of river basins.

About 10 percent of global fish production comes from aquaculture: approximately 7 million tons from freshwater aquaculture and 5 million tons from mariculture. At present growth rates, production by the end of the century should have almost doubled. In areas of high production, environmental problems are already apparent and will affect further growth in the sector. (See panel, page 57.) To avoid this situation, planning should cover areas such as environment, social interests and economic policies (including credits and incentives).

Sustainable development is particularly relevant to fisheries since it implies increasing the benefits from aquatic resources without decreasing the resource or stock beyond some optimal and sustainable level. The concept of sustainability has always been the basis of fisheries management. It includes the sustainability of the biological resource, its value and the social benefits deriving from it. It also implies an assumption of reversibility. Exploitation will inevitably affect the abundance, spawning biomass and species composition of a fishery resource, and the need to conserve options for future generations implies that such effects should be reversible within some practical time-frame.

In the aquatic environment, sustainability does not mean constancy. Since the seventies, short-term variations in marine resources due to fishing and natural fluctuations have been recognized as important factors in assessment and management. The interaction between fishing and the species making up the resource is also an important factor. Under heavy fishing pressure, species dominance changes towards small, short-lived pelagic species, thereby modifying the resource base and the options available for development.

Conservation of aquatic biodiversity poses problems at two main levels. In wild stocks, the loss of species (and more especially local races) through bad fishing practices, environmental change or species introduction (including escapes of cultured species), is a real and persistent danger. In cultured species, the need to develop new strains and conserve favourable ones is increasing.

Fisheries and aquaculture have, to a certain extent, lagged behind other sectors of agriculture and forestry in the exploitation of genetics and biotechnology for management and development. However, the effects of present fishing and management practices on wild fish stocks, and the advantages of genetic manipulation to aquaculture, are becoming more apparent.

It is FAO's long-term goal to improve the national capacity of individual nations to deal with the complex issues of sustainable development of fisheries and their implications for environmental management. Although very few fishery resources are actually threatened by extinction, immediate action is required to stop the present trends towards degradation of resources and habitats, rehabilitate them and promote the conditions necessary for sustainable development. FAO's priorities are to improve the quality and accessibility of information, to strengthen fisheries institutions and their planning and decision-making mechanisms, and to strengthen the international legal framework of fisheries development. With special reference to marine environmental protection, comprehensive strategies should be developed that will take into account all available options for waste disposal on land and in the sea, and that will avoid the error of considering the marine environment in isolation. With this aim in mind, FAO participates in the Group of Experts on the Scientific Aspects of Marine Pollution (GESAMP) which is jointly sponsored by IMO, FAO, UNESCO, WMO, WHO, IAEA, UN and UNEP.

# PART 4:
# SOCIO-ECONOMIC ASPECTS OF SUSTAINABLE DEVELOPMENT

## *AGRICULTURAL POLICY*

**THE SUCCESS OF AGRICULTURE** in terms of increased production and sustained rural income depends to a very large extent on the development of appropriate government policies. They are as important as the availability of appropriate technology, adequate capital, effective institutions and people's participation.

The term 'policies' covers a vast range of subject-matter. In the national context, they are of fundamental importance for the economy as a whole, since they determine, for example, whether agricultural prices should favour producers or consumers or whether tractors should replace animal power. Some policies have international dimensions, such as the fixing of quotas and prices for internationally traded crops such as coffee or rubber, while others have regional dimensions, such as food security or inter-country trade in agricultural commodities among groups of countries (e.g. SADCC or ASEAN).

FAO's credentials in this field derive mainly from its work at global and regional levels. In the context of the individual country, decisions on policy are matters of national sovereignty and in the 1950s and 1960s technical organizations such as FAO were not regarded as having a direct role in the shaping of national policies.

Attitudes have changed, however, and while it remains true that national policies are the exclusive prerogative of the governments concerned, there has been a growing recognition - especially since the food crisis of the mid-seventies - that FAO can contribute usefully to the analysis that precedes policy decisions and be involved in the implementation process that follows. This change in mood is reflected in the 1987 Conference decision urging FAO to, 'step up its policy advice and training at the national level to help developing countries to formulate and implement appropriate food and agricultural policies that are suitable for rural men and women in line with national priorities and situations'.

Such assistance generally falls into one of three categories: comprehensive global policy studies and strategies; regional and sub-regional policy studies and strategies; and policy advice and planning assistance at country level. The emphasis is on the design of development policies and their translation into plans and programmes.

In view of its global mandate, FAO's role in policy analysis and planning has four main elements:

—establishing codes of conduct, norms and decision-making criteria which provide a normative framework;

—developing new approaches and techniques that facilitate policy analysis and planning;

—organizing and servicing inter-governmental meetings where policy issues are discussed and decisions reached; and

—providing direct assistance to Member Countries, individually or collectively, in reviewing policies and performance, redesigning development policies and translating them into plans and programmes.

While each of the above represents an important role individually, they are closely linked, especially in the case of major policy and planning frameworks

such as WCARRD, the Fishery Resources Management and Development Programme, the Tropical Forestry Action Programme, the World Soil Charter, the International Undertaking on Plant Genetic Resources and the International Code of Conduct on the Distribution and Use of Pesticides. FAO is well equipped to take a multidisciplinary approach to policy and planning. This is particularly evident in sector planning which calls for interventions in all sub-sectors and so requires the consideration of strictly technical aspects within a macro-economic framework.

Much of FAO's work in the policy field is of direct interest to other organizations and involves close cooperation with other agencies, particularly but not exclusively within the United Nations system. Examples are Food Security (World Bank), WCARRD (most UN agencies through the ACC Task Force on Rural Development), TFAP (World Bank and UNDP), Commodity Policies (UNCTAD, GATT and the international commodity organizations) and Nutrition Policies (WHO, World Bank and UNICEF and other organizations, through the ACC Sub-Committee on Nutrition).

In some areas there is close cooperation with non-UN organizations, often through FAO's Regional Offices. Examples include the support given to the Joint Anti-Locust and Anti-Avian Organization in the context of the Special Action Programme for the Control of Locusts and other Plant Pests.

WCARRD principles have guided nearly all FAO policy and planning activities since 1979, but the ultimate test of success is whether the advice rendered did indeed contribute to the development of more efficient agriculture, improved nutrition for consumers and greater rural equity. However, many factors stand between the formulation and execution of a policy or plan and the realization of benefits at grassroots level. Most, if not all, are beyond FAO's influence. They depend on the determination of national governments to take the necessary complementary actions and, ultimately, on the decisions taken at village and community level, especially the extent of people's participation in the development process. Any attempt to assess FAO's achievements must be undertaken with this caveat in mind.

The FAO/Netherlands Conference on Agriculture and the Environment (s'Hertogenbosch, The Netherlands, 1991) recognized the close links between the economic, ecological and social factors of viability and sustainability. Among the fundamental changes that the den Bosch Declaration recommends is the adjustment of macro-economic and agricultural policies and instruments in order to promote production systems and technologies that can help attain the objective of sustainable agriculture and rural development (SARD). This means, *inter alia*, at the country level:

—launching a process of macro-economic policy adjustment and agricultural policy review leading, where necessary, to local and national SARD plans and programmes, the establishment of appropriate mechanisms associating government and non-government interests, and the selection of appropriate tools and instruments for policy analysis and implementation, including the development of data bases and monitoring systems;

—ensuring integrated planning, community-based resource management and related investment in key resource areas, namely land, water and biological diversity;

—providing supporting services and training to ensure the best use of local natural resources, particularly for the development and management of renewable energy sources (e.g.wind, biomass and solar power);
—developing criteria, indicators and methods with which to assess and monitor the sustainability of agriculture and the impact of technology and in order to set up environmental and natural resource accounting systems.

The FAO Council, at its June 1991 session, recognized that in implementing these recommendations a high level of priority should be given to strengthening the process of sector policy review and analysis with regard to the impacts of existing policies on the sustainability of the natural resource base and the development of the agricultural/rural sector. FAO is therefore assisting Member Countries in formulating sustainable development policies, analysing the potential impact of macro-economic and sector policies on the sustainability of the resource base (see panel, below), predicting the impact of population pressure on land and natural resources, monitoring the evolution of fragile ecosystems at national and local levels and assessing the environmental impact of agricultural projects and programmes. (See panel, page 62.)

In the context of the International Cooperative Programme Framework, a Special Action Programme has been proposed to strengthen FAO's activities in

## *STRUCTURAL ADJUSTMENT AND THE ENVIRONMENT*

There is growing concern about the potentially negative consequences of macro-economic policies for developing countries' natural resources. The debt crisis demonstrated how efforts by some countries to repay loans could lead to unsustainable practices: for instance, encouraging logging or land clearing for agriculture in humid tropical lowlands, in order to generate export earnings, may provide only a short-term solution for debt repayments. When these areas are not reforested or cultivated properly they rapidly lose their economic potential. Programmes designed to deal more adequately with environmental problems, such as debt-for-nature swaps, are now addressing these important issues. At present, five countries, (Bolivia, Costa Rica, Ecuador, Madagascar and the Philippines) have participated in debt-for-nature swaps, reducing their external debt by about US$100 million.

Current research is also examining how basic market failures in some developing countries limit the usefulness of adjustment policies that would otherwise encourage environmentally sound agricultural practices. These failures include market prices that do not reflect environmental costs; a divergence of the private and social discount rate leading to a misallocation of resources; and property rights leading to inconsistent economic incentives. For example, landless agricultural labourers may be forced to farm on fragile hillsides because land market conditions limit their access to more cultivable farmland. At the same time, insecure land rights often determine whether those hillsides are planted with permanent tree crops or with annual crops which may eventually lead to serious soil erosion.

Likewise, exchange-rate and trade policies influence the cost of imported inputs, as well as the profitability (and hence the nature and scale) of export crop production. Recognizing the need for structural adjustment, while being aware of its possible adverse impacts, FAO has conducted studies to improve understanding of the structural adjustment process itself and its socio-economic and environmental impacts also provides technical assistance at the request of Member Countries to help them implement structural adjustment programmes that will minimize the threat to their natural resources.

## *ENVIRONMENTAL ACCOUNTING*

Current indicators of economic performance usually fail to account for the consumption or the degradation of non-renewable natural resources. Concurrently, the cost of their conservation and maintenance is not adequately assessed. If the price of food does not include the cost of conserving the land on which it is produced, or the replenishment of the nutrients it withdraws from the soil, it then means that with the food we eat we deplete the natural resource capital. Traditional accounting seldom considers natural resources as economic - assets except for raw materials such as logs or minerals which can be traded. For instance, deforestation is often encouraged by underpricing logging licences. The low licence fee fails to take into account the true opportunity cost of the forest and so discourages interest in reforestation. The conversion of forests to other uses is generally treated purely as a short-term income benefit with no off-setting of accounts for the costs of depleting the capital asset which the resource represented. On the other hand, limitations of land use on environmental grounds may threaten the income of rural communities, for example by restricting the use of inputs through legislation or the elimination of price supports. Both degradation and protection have a price, not only monetary but also in terms of socio-economic trade-offs.

It is increasingly recognized that 'environmental accounting' must become an accepted tool in guiding policies for the management and use of natural resources.

There are two approaches to environmental accounting:

—a physical approach in which sources and uses of natural resources are quantified and used to develop measures of environmental change and ecological stress; and

—monetary approach aimed at adjusting national income accounts in order to incorporate measures of depletion or other environmental changes - such as pollution in the natural resource base.

While present methods are still in need of considerable refinement, a recent report on Indonesia shows the importance of such procedures in ensuring that policies do not over-emphasize short-term gains at the expense of long-term sustainability. When net domestic production (NDP) for the period 1971-1984 was adjusted to take account of natural resource depletion in petroleum, timber and soils on Java, the value of gross domestic product (GDP) fell from an average annual rate of 7.1 percent to only 4 percent. Similar adjustment of net domestic investment (NDI) showed that while NDI increased in 1971 and 1974 due to additions to petroleum reserves, in most years resource depletion was substantial. In 1979 and 1980 net investment was negative, implying that natural resources were being used to finance current consumption.

The mass of natural resource information which FAO has established over the years should be extremely valuable to Member Countries in initiating or developing resource accounting. With special reference to soil resources it should be stressed that these are non-renewable. Once eroded or destroyed, soil cannot be replaced even by introducing a 'soil depreciation allowance' in the accounting procedures. It is essential, therefore, to assess the suitability of land for specific types of use, and to establish at the outset the limits beyond which 'mining' - that is capital consumption - sets in. Exploratory work and testing of methodologies for environmental accounting are under way, and a few governments are endeavouring to apply these methodologies to the management of national renewable and non-renewable resources. The tools and techniques to be applied include environmental cost-benefit analysis, environmental impact assessments, multi-goal programming and the establishment of input-output balance sheets.

The UN Statistical Office is attempting to define a framework within which changes in the value of natural assets as well as defensive expenditures and the costs of residual pollution can be taken into account. The framework involves the use of specific stock accounts, defining opening and closing balances of produced and environmental assets. These stock accounts include:

—renewable biological assets, such as those pertaining to agriculture, forestry and fisheries;

—scarce renewable resources in the public domain, such as marine resources, tropical forests;

—non-renewable resources, such as mineral deposits, and

—cyclical resources, such as air and water.

Natural assets that could be replaced by man-made assets would be valued at replacement cost, while complements would be valued by the "marginal willingness to pay" to preserve the resource.

Sustainable development in low-potential areas requires special attention. In drylands, mountain areas, wetlands and acid soils in the humid tropics, farm production systems should aim at minimizing risks, and should enable the farm-household to withstand the shocks and stress of an unfavourable natural resource environment.

Sector and Structural Adjustment Policy work and in particular to reinforce the incorporation of environmental and sustainability considerations into the mainstream of agricultural planning and policy analysis in developing countries. None of these fields is new to FAO, but they do require further integration of specialized knowledge, an enhanced interdisciplinarity, and interdivisional cooperation. FAO has therefore made a number of new institutional arrangements, including the establishment of a coordination mechanism for country policy work and interdepartmental working groups to strengthen interdisciplinary cooperation for policy advice on SARD (see page 22).

The general objective of FAO's assistance and training in SARD policy analysis and planning is to strengthen Member Countries' capabilities to plan, monitor and manage their agricultural development programmes in a sustainable manner. To this end, FAO is assembling and developing a set of proven methodologies and related training opportunities for policy analysis and planning for SARD and providing technical assistance and training in the above areas to countries in collaboration with other national and international institutions.

## AGRARIAN REFORM AND RURAL DEVELOPMENT

FAO's search for equity aims principally at securing fair treatment for small farmers and landless labourers through agrarian reform and rural development. Agrarian reform, implying a redistribution of economic (and ultimately political) power at the national level, is obviously a delicate subject for an international organization to handle, and the present stance of FAO was reached through a process of gradual evolution. Initially the overall approach was that "agrarian reform must be part and parcel of the general programme of economic development", and during the 1950s, the Organization viewed agrarian reform, particularly the improvement of land tenure conditions, as an essential step in increasing production.

**Rural development programmes of FAO are designed to reach the rural poor. A young farmer in Nepal learns how to use a hand tractor in a project that introduces farming machinery at the village level.**

During the 1960s, the emphasis shifted towards helping individual countries implement agrarian reform projects. The World Land Reform Conference, convened by FAO in 1966, led to a more action-oriented consensus in the 1970s. Since the pace and extent of agrarian reform had previously been slow, the new strategy attached increased importance to fostering rural organizations as a channel for peasants' participation and decision-making. In 1974 the Administrative Committee on Coordination of the United Nations recommended that its organizations should adjust their programmes in rural development to ensure that benefits accrued primarily to the rural poor.

This concept found a ready response and FAO suggested that the twin themes of agrarian reform and rural development be brought together in a world conference. The proposal was supported in the Economic and Social Council and led to the World

Conference on Agrarian Reform and Rural Development (WCARRD) which assembled at FAO Headquarters in Rome in July 1979. The participants included four heads of state, 89 ministers and 25 vice-ministers. The outcome fully justified the elaborate preparation and the distinguished attendance. WCARRD adopted, without major confrontations or fundamental disagreements, a Declaration of Principles and a Programme of Action which together constitute a historic landmark, not only for FAO but also for the evolution of development thinking and policies in general. (See panel, below.)

The WCARRD Declaration of Principles and Programme of Action represent the high point of FAO's search for equity. At the same time, they illustrate very clearly the gulf that divides an international consensus on what is desirable from national decisions on what will actually be done. FAO provides a forum for setting the targets, but their attainment depends almost entirely on action by individual governments. The Organization's own programme has been reoriented towards WCARRD objectives, but its role is to support rather than replace initiatives at country level.

National action to implement the agreed recommendations of WCARRD may so far have been less than impressive, but there has been progress on a number of specific points. The spirit of the Conference lives on through the goals it set and the monitoring mechanisms it established. Its ultimate significance will depend on what happens in the decades ahead.

## *THE PEASANTS' CHARTER*

July 1979 marked an important milestone in the long and difficult struggle against poverty and hunger: the adoption in Rome by the World Conference on Agrarian Reform and Rural development of a Declaration of Principles and Programme of Action. At that time, the 145 governments represented at the World Conference gave FAO a mandate to assist countries in implementing the provisions of this important document. Six main areas were identified for national action for rural development:

— access to land, water and other natural resources;

— access to inputs, markets and services;

—integration of women in rural development;

— development of non-farm rural activities;

— people's participation; and

— education, training and extension.

The Declaration of Principles and Programme of Action constitutes the charter of the rural poor. It points out that rural development is a global problem, which has to be tackled simultaneously on several inter-connected fronts: by the action of rural institutions at village level; by the reorientation of national development policies at country level; and by the creation of better international relationships.

Developed and developing countries, as well as the international community as a whole, must collaborate to eliminate rural poverty. The rural poor must be given access to land and water resources, agricultural inputs and services, extension and research facilities. They must be permitted to participate in rural development programmes. The structure and pattern of international trade and external investment must be adjusted to facilitate the implementation of poverty-oriented rural development strategies.

The Peasants' Charter recognizes that growth is necessary but not sufficient: it must be buttressed by equity and, above all, by people's participation in designing, implementing and evaluating rural development programmes and policies.

## FOOD SECURITY

From the 1950s to the early 1970s the presence of large stocks of cereals in North America was taken for granted, but in 1972 grain production fell simultaneously in several of the main producing areas. Import needs rose and the surpluses disappeared almost overnight. Cereal prices more than tripled while fertilizer prices more than quadrupled, leaving the poorer importing countries in grave danger of being unable to obtain the supplies of food and fertilizer they needed.

The onset of the 'world food crisis', the outcome of the ensuing World Food Conference of 1974, and the emergence of a new era of increased volatility in international markets for basic foodstuffs were among the main factors that combined to give FAO's work on world food security new dimensions and renewed importance over the past two decades.

**The suddenness of the world food crisis highlighted the need for an international system to provide timely warnings of impending food shortages.**

The suddenness of the world food crisis highlighted the need for a continuous flow of reliable and up-to-date information on the supply of basic foodstuffs, and for an international system to provide timely warnings of impending food shortages. These objectives form the basis of the work of FAO's Global Information and Early Warning System for Food and Agriculture (GIEWS), which has been in operation since 1975 and in which over 100 countries now participate. The value of the Early Warning System has been widely demonstrated, having provided advance warning of the serious food emergencies in Africa during the 1980s.

The second dimension in FAO's role to promote world food security is the Food Security Assistance Scheme (FSAS), set up in 1976 to help developing countries map out their national food security policies, identify projects - particularly for improving their food security infrastructures - and mobilize funds to bring such projects to fruition. Projects financed under the Scheme have been directed mainly towards setting up or expanding food storage facilities at national level, training to improve stock management, and establishing and improving national early warning systems.

The third dimension is in the policy area, particularly through the Committee on World Food Security (CFS). The main functions of the CFS, set up in accordance with a resolution of the 1974 World Food Conference, include recommending policy actions designed to ensure adequate cereal supplies for minimum world food security, and reviewing implementation of the International Undertaking on World Food Security, agreed in 1974 as a principal mechanism towards this objective. This was followed in 1979 by the FAO Plan of Action on World Food Security which, among other things, helped to promote the development of a new 'food financing facility' by the International Monetary Fund. In 1981, agreement was reached on an Agenda for Consultations and Possible Action to deal with Acute and Large-scale Food Shortages. In 1983, a broadened concept of world food security was developed by the CFS, focusing on action to promote food production, stability of supplies, and access to food by the poor. The ultimate objective of this concept of food security is to ensure that all people at all times have both physical and economic access to the basic food they need. In 1985, the CFS adopted a World Food Security Compact which was later approved by the FAO Conference. The Compact distills and incorporates into a single text the principles contained in previous international understandings and agreements initiated by FAO and other organizations, and highlights the need for multifaceted action to achieve the goal of providing adequate food for all people.

Within this overall context, FAO is strengthening its operational programme in support of food security objectives. Major activities include: promoting food production on a sustainable basis; improving food storage and processing at household level; strengthening market institutions; improving disaster prevention and relief; providing direct support to people, and strengthening food security institutions.

Activities that help to ensure adequate food supplies focus on promoting food production on a sustainable basis. They relate to the management and conservation of natural resources, forestry, crop production, animal husbandry, fisheries, and research and technology. Activities under these programmes promote food production while at the same time safeguarding against environmental degradation. (See panel, below.)

Activities that contribute to stability of supplies generally have the objectives of strengthening food storage and processing at household level, strengthening marketing institutions, and improving disaster prevention and relief. They include prevention of post-harvest food losses through such activities as improving the suitability of the product for storage and introducing improved equipment and technologies; training in quality control, storage practices and appropriate pest control; the creation and management of village-level farmers' associations; the introduction of seasonal credit; and the promotion of pre-storage and storage technologies. In the area of market management and food security reserves, activities aim at developing national capacity to develop

## *THE ARTEMIS AND DIANA SYSTEMS*

Since 1976, FAO's Remote Sensing Centre has been developing and testing the operational use of data from environmental and earth resources satellites for improving the Global Information and Early Warning System for Food and Agriculture (GIEWS) and the Desert Locust Plague Prevention Programme.

The environmental satellite monitoring system, Africa Real-Time Information Monitoring System (ARTEMIS), developed in cooperation with the NASA Goddard Space Flight Centre, the National Aerospace Laboratory of the Netherlands, and the Universities of Bristol and Reading in the UK, has been in operation since August 1988. The system covers Africa, Southern Europe, the near East and Southwest Asia, and produces a range of ten-day and monthly cloud-duration, estimated rainfall and vegetation index maps. These are available in both photographic and digital IBM-PC-compatible formats. The system also produces ten-day composite vegetation index maps of the desert locust recession area of West Africa.

Current users of the ARTEMIS output are the GIEWS, the Emergency Centre for Locust Operations (ECLO), the Office of Special Relief Operations (OSRO) and the Agrometeorology Group of the FAO Remote Sensing Centre, in addition to 16 countries of the IGADD and SADCC regions. ARTEMIS is currently being extended to cover the rest of Asia and Central and South America.

While information from the ARTEMIS system is communicated to recipient and donor countries in analyzed form, as telexed summaries and printed bulletins, rapid communication of the high volume of basic data requires special facilities.

In cooperation with the European Space Agency (ESA), the Remote Sensing Centre has formulated a project for the development of a dedicated satellite communications system. The Direct Information Access Network for Africa (DIANA) is based on low-cost microcomputer technology and uses the commercial Intelsat satellites through the facilities of Telespazio in Fucino, Italy. The DIANA system will provide high-speed, tow-way transfer of facsimile documents and maps, character-coded text and digital images in raw or processed form between FAO Headquarters and microcomputer-based regional and national user terminals.

appropriate marketing policies and infrastructures, and at establishing rural marketing centres and strengthening the role of cooperatives. Assistance in establishing national and regional early warning and food information systems is designed to help prevent large-scale food shortages in the country or countries concerned.

Activities that contribute to improving access to food by the poor concentrate on providing direct support to food-insecure people and relate mainly to support of rural development and nutrition schemes. In this area, activities that support skills improvement and the development of income-generating activities for the rural poor contribute directly to improving access to food supplies. Projects that support crop, livestock, forestry and fisheries production, and strengthen extension, marketing and credit services, increase the income of the poor - a large part of which is, in turn, invested in improving the resource base and thus strengthening longer-term sustainability. Direct nutrition intervention schemes generally lead to an immediate improvement in the nutritional status of vulnerable groups, especially women and children. Other activities that help to improve access to food include developing national food and nutrition policies, designing efficient nutrition intervention and feeding programmes, and providing technical know-how on food quality control, food safety and food standards.

Finally, strengthening food security institutions, particularly through food and agricultural policy and planning assistance, provides a firm foundation for the implementation of national food security strategies and action programmes. In addition to its traditional activities mentioned above, the Food Security Assistance Scheme has since 1989 helped countries develop comprehensive food security policies and related action programmes. The FSAS is currently assisting four countries (Chad, Niger, Tanzania and Zambia) in the preparation of such programmes.

## THE LEGAL FRAMEWORK

**Sustainable development and environmental protection need to be supported by appropriate legislation.**

Sustainable development and environmental protection need to be supported by appropriate legislation. A long-term objective is to equip countries with a legal and institutional framework that responds to the goals of sustainable agriculture, forestry and fisheries. In the short term it is necessary to identify the legal and institutional ramifications of the development of agriculture-related natural resources. FAO programmes relevant to these subjects include legal advisory services, agricultural planning assistance, assessment and planning of natural resources development and protection, conservation and rehabilitation.

The Organization's mandate encompasses the legal aspects of preventing and controlling the degradation of natural resources, with particular reference to desertification, arid grasslands and soil rehabilitation; salinization and waterlogging of irrigated areas; conservation and development of genetic resources; degradation of watersheds; pollution resulting from agricultural activities; management of fresh water, forests, wildlife and protected areas; and marine pollution and flood control.

A key function of FAO is to provide technical assistance to Member Governments in formulating legal instruments to implement agricultural policies, programmes and projects. This may include the preparation of laws, regulations, agreements, and standard licensing conditions for conservation and management of natural resources, trade in agricultural products, food and feed control, and issues concerning rural development and agrarian reform. At the same time, the

status of international conventions and agreements for which the FAO Director-General exercises depository functions, or which were concluded under the FAO Constitution, is periodically up-dated by FAO's Legal Office. A number of these conventions and agreements relate to the environment (e.g. plant protection, locust control and fisheries management).

During the past 20 years, legal assistance has been given to numerous states in Africa, Asia, Central and South America in the drafting and/or amending of laws and regulations dealing with food, environment, forestry, wildlife, land, fisheries, water, plants and pesticides. Cape Verde, Guinea, Liberia, Mauritania, Sierra Leone and Togo are among more than 50 countries that have passed laws and regulations based on FAO's legal advice.

In the field of environment and sustainable development, FAO proposed in 1990, through its Committee on Forestry, to initiate work on a conceptual framework for forest conservation and development at global level. This work has served in the preparation by the Preparatory Committee of UNCED of a "non-legally binding authoritative statement of principles for a global consensus on the management, conservation and sustainable development of all types of forests" that would be considered at the UN Conference on Environment and Development.

With respect to fisheries, FAO's activities aim at ensuring a more environmentally sound utilization of marine living resources. A specific area of interest is large-scale pelagic driftnet fishing, and following the UN General Assembly Resolution 44/225 on the subject, FAO undertook a series of studies of the scientific, technical and legal aspects of the practice. Studies have also been undertaken on the high seas fisheries legal regime with particular regard to conservation and management aspects, and in 1991 the Organization published *The regulation of driftnet fishing on the high seas: legal issues.*

In response to international concern over the loss of biological diversity, FAO has prepared an Outline for a Draft International Convention on the Conservation and Sustainable Use of Biological Diversity as a contribution to on-going efforts to prepare an international instrument in this field. The Organization is also preparing an International Code of Conduct for Plant Germplasm Collection and Transfer, a preliminary draft of which was discussed at the December 1990 meeting of the Working Group of the FAO Commission on Plant Genetic Resources. An International Code of Conduct for Biotechnology as it affects the conservation and use of plant genetic resources is being processed, and an International Undertaking on Animal Genetic Resources is being prepared.

A series of FAO Legislative Studies deals with environmental matters, for example *The environmental impact of economic incentives for agricultural production: a comparative law study*, published in 1990.

## ENVIRONMENTAL MANAGEMENT

### *Environmental guidelines*

A fundamental shift in the emphasis of FAO's work in recent years has been to address sustainability not only at project level but also during policy formulation, programming and planning.

Since human resource development is a prerequisite for sustainable development it has received special attention in many FAO programmes through

environmental education and training activities and TCDC networking arrangements. Training of target groups is provided through land-use and soil fertility projects as well as through crop, grassland, forestry and gender-oriented projects. These are often complemented by awareness-raising seminars and environmentally-focused workshops. Numerous publications relating to sustainable development are published for wide dissemination as an integral part of the Organization's ongoing programmes.

### *Environmental impact assessment*

Properly designed development projects must minimize any adverse environmental impacts and at the same time enhance any available opportunities for environmental improvement. Environmental impact assessment (EIA) is an important tool in achieving these goals, and since 1989 FAO has incorporated EIA into its field projects through the application of set procedures developed by the Inter-departmental Working Group on Environment and Energy.

In brief, the three main stages of environmental impact assessment are:

—screening to identify projects that are unlikely to create environmental problems;

—preliminary assessment of projects deemed to have limited environmental implications that can be readily overcome, and

—detailed assessment of projects having potentially more serious environmental consequences.

An in-house seminar on EIA held in October 1989 was attended by 42 representatives from 16 divisions of the Organization, and since then numerous initiatives have continued to strengthen the environmental component of FAO's in-house seminars and courses. Lectures on the theme of "Protection of the Environment" are included in the training seminars for National Project Directors and Programme Officers, held four times yearly, and during the biennium 1990-91 an EIA element was included in the "Basic Workshop an Technical Cooperation Project Formulation and Appraisal", held on average five times a year and intended for all professional staff including field staff and Associate Professional Officers.

The work on in-house training was extended in 1990 with the establishment, by the Special Adviser to the Director-General, of an *ad hoc* Task Force charged with strengthening the environmental component of FAO's field programmes. Based on the earlier EIA guidelines, the Task Force has developed specific procedures to ensure that environment and sustainable development considerations are incorporated into all activities related to policy advisory work, including planning assistance, programming missions and field projects.

### *Investment and the environment*

Because of their large size and their potential for significant long-term impact, the agriculture, forestry and fisheries investment projects identified and/or prepared by FAO's Investment Centre for financing by the World Bank, regional development banks, IFAD and other institutions must be considered from the

point of view of their likely environmental impact as well as for their physical and financial/economic sustainability.

Recently, and in order to enhance the sensitivity of Investment Centre staff to these considerations, the Centre has established a small multidisciplinary team to ensure that newly evolving procedures and methodologies are incorporated fully into the Centre's project design activities.

In a number of cases, technical cooperation work carried out under FAO's technical divisions has been of direct benefit in the preparation of investment plans. For example, FAO's work on modern approaches to soil conservation has been of crucial importance to the Centre. Instead of involving costly civil works, the new approaches promote enhanced biomass cover and soil and water conservation while increasing productivity and thus also improve the short-term returns to the land user. By demonstrating that such approaches to sustainability are potentially 'bankable', this technical assistance by FAO has paved the way for new investment possibilities.

# CONCLUSIONS AND FUTURE OUTLOOK

## A FRAMEWORK FOR ACTION

**FAO HAS LONG BEEN CONCERNED** with the varied and interconnected components of what is now defined as sustainable development. In accordance with its mandate, the Organization has included among its functions the conservation of natural resources and the adoption of improved methods of agricultural production. Moreover, the objectives set out in the preamble to FAO's Constitution, "raising levels of nutrition and standards of living", "securing improvements in the efficiency of the production and distribution of all food and agricultural products" and "bettering the conditions of rural populations", constitute major contributions to sustainable development.

As problems have evolved and pressure on the natural resource base has increased, experience from field projects and the Regular Programme has enabled the Organization to adapt its activities in a way that makes them particularly responsive to environmental problems and people's needs. In the years to come, FAO will link its Regular Programme and its field activities ever more closely.

In implementing a strategy for sustainable agriculture and rural development within a common programme framework, five major areas emerge:

—sector policy assistance;

—people's participation and human resource development;

—integrated production system management and diversification of rural incomes;

—sustainable use of basic natural resources; and

—safe and sustainable use of key agricultural inputs.

**Sector policy assistance** currently includes three components which have to be closely related:

—policy assistance involving sector and sub-sector policy reviews and analyses, advice and assistance in incorporating environment and sustainable development in mainstream policy and planning, and national capacity building;

—comprehensive food security programming under FSAS; and

—on-going work in the WCARRD follow-up at policy level.

**People's participation and human resource development** are central to sustainable agriculture and rural development. Activities under this heading include projects and programmes related to environmental education, training and extension; farming systems development; institution building; the promotion of people's participation; support to group actions, cooperatives and NGOs, including the development support communication projects; and the Plan of Action on Women in Development.

**Integrated production system management and diversification of rural incomes** form the third central thrust for sustainable agriculture. They include

programmes and projects to support integration and increased production of traditional food crops, livestock and wildlife; the diversification of incomes from other non-agriculture activities such as fisheries (e.g. aquaculture), forestry and agroforestry; projects to develop processing industries and agro-allied industries in rural areas as sources of non-farm employment; and projects to improve integrated farm management, marketing systems and credit.

**Sustainable use of basic natural resources** calls for the provision of specialized support to policy formulation and planning, local community development programmes and integrated production systems management and diversification programmes. These include:

—projects related to land resources, including land resource assessment, land-use planning and land zoning, conservation, rehabilitation and management (for example, the Programme for the Conservation and Rehabilitation of African Lands);

—projects related to the use of water for sustainable agriculture (a programme has already been formulated in support of the implementation of the Mar del Plata Action Plan); and

—projects related to the conservation and use of biological diversity in agriculture and the conservation of plant genetic resources in cooperation with IBPGR and animal genetic resources.

**Safe and sustainable use of key agricultural inputs** is the other major area where services are needed in support of sector policy review, local community development and integrated production system management. Three major components are included:

—regional and national projects on Integrated Pest Management (IPM) and in support of the implementation of the Code of Conduct on the Distribution and Use of Pesticides;

—projects on Integrated Plant Nutrition Systems (IPNS) which encompass those of the on-going Fertilizer Programme and related projects (for example biological nitrogen fixation); and

—projects on energy for rural development.

These activities are being incorporated into an International Cooperative Programme Framework for Sustainable Agriculture and Rural Development (ICPF/SARD) which the 1991 FAO Conference decided to launch as a means of streamlining and rationalizing further a number of FAO field programmes and projects and related support activities of its Regular Programme (see page 22). Parallel efforts are being made in the fields of forestry and fisheries with a view to focusing better the FAO action on sustainable development objectives.

## FAO CONTRIBUTIONS AND FOLLOW-UP TO UNCED

**WHILE PLACING AN INCREASED FOCUS** and streamlining its programmes toward sustainable development, FAO has played a major role in the preparation of the UN Conference on Environment and Development (UNCED, Rio de Janeiro, 3-14 June 1992). It cooperated closely with the UNCED Secretariat for the preparation of a wide range of basic documents and proposals for UNCED Agenda 21 by providing background material and data. It participated in UNCED inter-agency task forces on land degradation, sustainable agriculture, forests, biodiversity, fresh waters, oceans, toxic chemicals and poverty and provided technical advice prior to and during the four successive meetings of the UNCED Preparatory Committee.

In line with the recommendations of the governing bodies which requested FAO to participate actively in UNCED, promoting the interests of the food, agriculture, forestry and fishery sectors, FAO convened a series of meetings at intergovernmental level with a view to assisting the ministries concerned in its Member Nations in formulating their priorities and positions on a number of topics addressed by UNCED. These meetings included *inter alia*:

—those of the Technical Committees of FAO (Committee on Agriculture, Committee on Forestry, Committee on Fisheries), FAO Council and Conference which in 1990 and 1991 included the preparations for UNCED on their agenda;

—the FAO/Netherlands Conference on Agriculture and the Environment (den Bosch, 15-19 April 1991);

—two Intergovernmental Conferences on Sustainable Development and Environment in Agriculture, Forestry and Fisheries, one for small island countries held in Bridgetown, Barbados, (7-10 April 1992) and another for Latin American and Caribbean countries held in Santiago, Chile (27-30 April 1992).

By participating actively in the preparation of UNCED and constantly streamlining its own programmes, FAO could ensure a fairly large degree of congruence between its future programmes and those proposed in the UNCED Agenda 21 in the sectors of its competence. Thus, FAO has prepared itself to act as a major partner in the UN System for the UNCED follow-up.

# APPENDIX 1

## FAO STRUCTURE FOR COORDINATION IN THE FIELD OF ENVIRONMENT AND SUSTAINABLE DEVELOPMENT

**ENVIRONMENT AND SUSTAINABLE DEVELOPMENT ISSUES** cut across the work of a number of divisions in different departments in FAO. In each of these divisions and departments, specific units address the environment problems related to their sector of work. Because of the very nature of FAO's work in agriculture, forestry and fisheries, it was not found advisable to establish a separate Environment Department or Environment Division. Instead an Interdepartmental Working Group on Natural Resources and the Human Environment was established in 1969. Responsibilities for energy were added in 1982, at which time the name was changed to Environment and Energy. The Environment and Energy Programmes Coordinating Centre (AGRE) serves as the secretariat of the IDWG. It ensures liaison and cooperation in these fields, both within the Organization and with other institutions. It is also charged with the elaboration and implementation of procedures and methodologies to ensure that environment and sustainability concerns are appropriately taken into account in FAO programmes and field projects (e.g. through environmental impact assessment).

In February 1990, the Director-General appointed a Special Adviser to the Director-General for Environment and Sustainable Development, with the rank of Assistant Director-General (ADG). The Special Adviser is responsible for providing guidance and advice for all policy and programme matters related to environment and sustainable development in the Organization. The Environment and Energy Programmes Coordinating Centre, now renamed Environment and Sustainable Development Coordinating Centre (AGRE), was requested to report directly to and be supervised by the Special Adviser.

Also in February 1990, the Director-General established a Steering Committee for Environment and Sustainable Development at ADG level under the Chairmanship of the Special Adviser/ADG for Environment and Sustainable Development. This Steering Committee is responsible for advising the Director-General in guiding and supervising FAO activities related to environment and sustainable development.

In June 1990, the Director-General announced revised Terms of Reference for the IDWG on Environment and Energy. The title of the IDWG was changed to the IDWG on Environment and Sustainable Development and its representation raised to Director level. It now reports to the Steering Committee. The main responsibilities of the IDWG are to develop proposals for multidisciplinary activities and to monitor and coordinate the implementation of these proposals, once endorsed by the Steering Committee.

Ad hoc groups and task forces of the IDWG continue to address certain specific technical matters and develop joint programme initiatives. At the present time such groups exist for the following topics: sustainable development, biological diversity, climate change, desertification control, and energy. (See panel, page 75.) Other interdepartmental mechanisms include the IDWG on Land Use Planning and its groups on Geographic Information Systems and Mixed Production Systems; and an Interdepartmental Steering Committee which helps to guide the TFAP.

FAO has a formal memorandum of understanding with UNEP which covers three main areas of mutual interest: environmental monitoring and assessment of food and agriculture (including forestry and fisheries); ecological management of natural resources for food and agriculture, and conservation and management of ecosystems. The FAO/UNEP Cooperative Programme is coordinated by AGRE.

FAO regularly attends meetings of the Designated Officials for Environmental

## FAO AND CLIMATE CHANGE (20)

FAO has a long history of involvement in climate-related issues. FAO is now revising its Position Paper on this topic, making use of information from the IPCC 1992 Update and mentioning some new programme initiatives.

In 1960 an Inter-agency Agroclimatology Project was created in cooperation with WMO to promote agroclimatological studies in areas where large-scale agricultural developments were anticipated. In 1968, FAO, WMO and Unesco established an Inter-agency Group on Agricultural Biometeorology - later to become absorbed into FAO's Regular Programme as the Agroclimate Unit.

The Stockholm Conference of 1972 and the 1974 World Food Conference were turning points in the perception of crop-climate relationships within FAO, and led to the establishment of the Agroecological Zones Project, designed to assess the food production potential of developing countries.

FAO's first direct involvement with climate change per se came in 1988 with the formation of the Working Group on Climate Change, and two years later the increasing importance attached to this issue led to the Group being absorbed into the Inter-Departmental Working Group on Environment and Sustainable Development. The 13 members of the Working group, drawn from the Departments of Agriculture, Fisheries, Forestry and Economic and Social Policy and the Legal Office, provide a coordinating mechanism for all FAO work related to climate change; provide a forum for assessing internal and external work in this field; formulate recommendations for FAO's Programme of Work and Budget, and play a central role in assessing, clearing and revising documents on climate change prepared by IPCC, FAO and other UN agencies.

FAO has maintained a constant involvement in the Inter-Governmental Panel on Climate Change (IPCC) since its formation in 1988, and was one of the co-sponsors of the Second World Climate Conference in 1990. The Organization is also involved in a wide range of related issues and activities ranging from the publication of guidelines for the assessment of the impact of climate change on irrigated agriculture to the development of regional impact studies on crops and the identification of low-lying coastal areas and fisheries ecosystems at risk from climate

Matters (DOEM), coordinated by UNEP, which is under the ACC mechanism for coordination on environmental matters within the UN System. The DOEM is the focal point for the UN System-wide Medium-Term Environmental Programme (SWMTEP) and the Cross-Organizational Programme Analysis (COPA) on Environment. FAO also regularly attends the annual meetings of the UNEP Governing Council.

FAO, along with UNEP, Unesco and IUCN, form the Ecosystems Conservation Group (ECG) which meets annually for joint programming in the field of ecosystem conservation and to review the conservation situation in selected countries/regions, particularly with respect to national parks and other protected areas, endangered species, and natural resources management. The Group exchanges information on current and planned activities of members in order to promote joint activities and meetings on specific problems. During the past three years, an ad hoc group on *in situ* conservation of genetic resources, chaired by FAO, has met simultaneously with the ECG.

FAO cooperates with Unesco through the Man and Biosphere (MAB) Programme in the areas of arid and semi-arid lands, soils, grasslands, forestry and especially in the Plan of Action on Biosphere Reserves. It also cooperates with the Intergovernmental Oceanographic Commission (IOC) on activities related to fisheries. It has had extensive collaboration with IUCN in the development of the World Conservation Strategy, the Environmental Status

Report on the Sahel, and in the development of national conservation strategies for Madagascar, Pakistan and the Philippines. FAO also cooperates in IUCN's Mangroves and Wetlands Programme and in UNEP's Oceans and Coastal Areas Programme. The Organization has also provided advice to IUCN, UNEP and WRI in the preparation of the Global Biological Diversity Strategy.

Other UN agencies with which FAO cooperates on environmental matters include WMO (on climatic change), WHO (on vector control, chemicals and food contamination) and UNSO (on desertification). FAO actively participates in the Consultative Group on Desertification (DESCON), the Interagency Working Group on Desertification, and the Committee of International Development Institutions on the Environment.

The Organization also has close links with many regional organizations and NGOs and particularly with umbrella organizations such as the Environment Liaison Centre International (ELCI). Currently, closer collaboration is being established with the Information Centre for Low-External-Input and Sustainable Agriculture (ILEIA) and the International Federation of Organic Agriculture Movements (IFOAM), as a follow-up to the den Bosch Conference. Cooperation also continues with the International Federation of Agricultural Producers (IFAP) on matters related to sustainable agriculture.

# APPENDIX 2

## GLOBAL AGREEMENTS

In recent years FAO has actively promoted several international agreements, codes of conduct and strategy frameworks relating to environment and sustainable agriculture. Among those concluded are:

—FAO's World Soil Charter, which was adopted by the FAO Conference in 1981. This has provided the framework for improved land use and is the basis of a planning package of land-use guidelines for assistance to Member Countries.

—The International Undertaking on Plant Genetic Resources (1983) which, through the Commission on Plant Genetic Resources and the Fund established in 1987, provides support for the preservation and use of germplasms collected worldwide.

—Following the UN Convention on the Law of the Sea, which recognized the rights of coastal states over their marine resources, the FAO World Conference on Fisheries Management and Development adopted in 1984 a Strategy for Fisheries Management and Development which provides a set of policy guidelines and priorities for the rational utilization of fishery resources, the development of small-scale fisheries and aquaculture, and the promotion of fish in national nutrition plans.

—The International Code of Conduct on the Distribution and Use of Pesticides was adopted by the FAO Conference in 1985 by consensus. Its objectives are to identify potential hazards in the distribution and use of pesticides, to establish standards of conduct and to define responsibilities for those engaged in the regulation, distribution and use of pesticides.

—The Tropical Forests Action Programme (formerly the Tropical Forestry Action Plan), adopted in 1985 by the Committee on Forest Development in the Tropics, provides an overall framework for investment planning in the forestry sector and support to national development plans.

# APPENDIX 3

## ACRONYMS

| | |
|---|---|
| **ACC** | Administrative Committee for Coordination |
| **ADG** | Assistant Director-General |
| **AGRE** | Environment and Sustainable Development Coordinating Centre (FAO) |
| **AGRIS** | International Information System for the Agricultural Sciences and Technology |
| **ARTEMIS** | Africa Real-Time Information Monitoring System |
| **ASEAN** | Association of South-East Asian Nations |
| **CARIS** | Current Agricultural Research Information System |
| **CFS** | Committee on World Food Security |
| **CILSS** | Interstate Committee for Drought Control in the Sahel |
| **COPA** | Cross-organizational Programme Analysis |
| **DESCON** | Consultative Group on Desertification |
| **DIANA** | Direct Information Access Network for Africa |
| **DOEM** | Designated Officials for Environmental Matters |
| **ECG** | Ecosystems Conservation Group |
| **EEZ** | Exclusive Economic Zones |
| **EIA** | Environmental Impact Assessment |
| **EPTA** | Expanded Programme of Technical Assistance |
| **ELCI** | Environment Liaison Centre International |
| **ELCO** | Emergency Centre for Locust Operations |
| **ESA** | European Space Agency |
| **FAO** | Food and Agriculture Organization of the United Nations |
| **FFHC** | Freedom from Hunger Campaign |
| **FLCD** | Forestry for Local Community Development (FAO) |
| **FSAS** | Food Security Assistance Scheme |
| **FTP** | Forests, Trees and People (FAO) |
| **GATT** | General Agreement on Tariffs and Trade |
| **GDP** | Gross Domestic Product |
| **GESAMP** | Group of Experts on the Scientific Aspects of Marine Pollution |
| **GIEWS** | Global Information and Early Warning System |
| **GIS** | Geographic Information System |
| **IAEA** | International Atomic Energy Agency |
| **IAP-WASAD** | International Action Programme on Water and Sustainable Agricultural Development |
| **IBPGR** | International Board for Plant Genetic Resources |
| **ICES** | International Council for the Exploration of the Sea |
| **ICPF/SARD** | International Cooperative Programme Framework for Sustainable Agriculture and Rural Development |
| **IDWG** | Interdepartmental Working Group |
| **IFAP** | International Federation of Agricultural Producers |
| **IFOAM** | International Federation of Organic Agriculture Movements |
| **IIASA** | International Institute for Applied System Analysis |
| **ILEIA** | Information Centre for Low-External-Input and Sustainable Agriculture |
| **IMO** | International Meteorological Organization |
| **IOC** | Inter-governmental Oceanographic Commission |
| **IPM** | Integrated Pest Management |
| **IPNS** | Integrated Plant Nutrition Systems |
| **IPCC** | Inter-governmental Panel on Climate Change |
| **IPPC** | International Plant Protection Convention |

| | |
|---|---|
| **ISSS** | International Society of Soil Science |
| **ITTO** | International Tropical Timber Organization |
| **IUCN** | World Conservation Union |
| **IWP** | Indicative World Plan |
| **MAB** | Man and the Biosphere Programme |
| **NDI** | Net Domestic Investment |
| **NDP** | Net Domestic Product |
| **NGO** | Non-governmental Organization |
| **OSRO** | Office of Special Relief Operations (FAO) |
| **PIC** | Prior Informed Consent procedure |
| **SAP** | Special Action Programme |
| **SADCC** | Southern African Development Coordination Conference |
| **SARD** | Sustainable Agriculture and Rural Development |
| **SIDA** | Swedish International Development Authority |
| **SIT** | Sterile Insect Technique |
| **SSAP** | Sector and Structural Adjustment Policy |
| **SWMTEP** | System-wide Medium-term Environment Programme |
| **TCDC** | Technical Cooperation among Developing Countries |
| **TCP** | Technical Cooperation Programme |
| **TFAP** | Tropical Forests Action Programme |
| **UN** | United Nations |
| **UNCED** | United Nations Conference on Environment and Development |
| **UNCTAD** | United Nations Conference on Trade and Development |
| **UNDP** | United Nations Development Programme |
| **UNEP** | United Nations Environment Programme |
| **Unesco** | United Nations Education, Scientific and Cultural Organization |
| **UNFPA** | United Nations Fund for Population Activities |
| **UNICEF** | United Nations Children's Fund |
| **UNSO** | United Nations Sudano-Sahelian Office |
| **WAICENT** | World Agriculture Information Centre (FAO) |
| **WCARRD** | World Conference on Agrarian Reform and Rural Development |
| **WFP** | World Food Programme |
| **WHO** | World Health Organization |
| **WMO** | World Meteorological Organization |
| **WRI** | World Resources Institute |

# APPENDIX 4

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